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STREPTOCOCCUS EMPYEMA*†

A STUDY OF THE CONDITION AS REVEALED BY THE ROENTGEN RAY

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NEW YORK CITY

THE unusual prevalence during the past year of empyema due to the streptococcus hemolyticus has done much to further our knowledge regarding the roentgen-ray diagnosis in diseases of the chest.

Starting, as a rule, with a local condition in the pharynx, the infection in these cases extends down the respiratory tract and invades the lungs, producing a condition varying from a simple bronchiolitis or peribronchiolitis to a broncho- or lobar

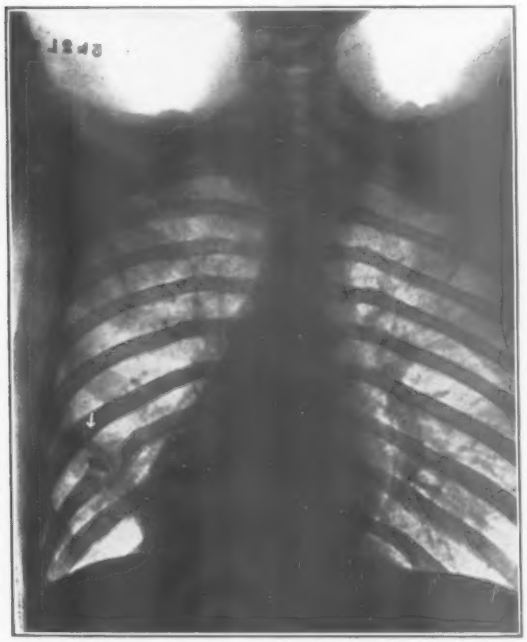

FIG. 1. PERSISTENT RIGID WALLED SINUS. NO INJECTION.

FIG. 2. OLD HEALED LEFT EMPYEMA. REMAINING PLEURAL THICKENING WITH PERICARDIAL ADHESIONS.

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pneumonia. It may or may not follow one of the acute infectious diseases, such as measles or mumps. There is a great tendency toward the formation of sub-pleural abscesses; many authorities claiming that

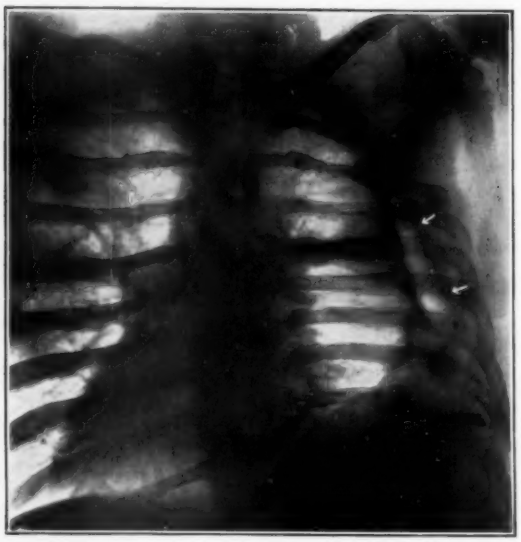

FIG. 3. OLD DRAINING RIGHT EMPYEMIC CAVITY IN THE MIDST OF EXTENSIVE PLEURITIC THICKENING.

the involvement of the pleura is secondary to the pulmonary lesion, and is probably caused by a rupture of one of these abscesses into the pleural cavity. The pleural effusion occurs very early, and is considerable in quantity: at first it is serous, but very soon becomes serofibrinous and, finally, frankly purulent. It appears during the course of the lung involvement and is not postpneumonic, as we are accustomed to see in the pneumococcus infection. The symptomatology, physical diagnosis, roentgen ray examination, and diagnostic aspirations, all come into play in making the diagnosis, and it is only by a complete correlation of the findings of these different diagnostic methods that we can hope to arrive at a correct conclusion.

The difficulties in many cases are that the subjective symptoms present much the same clinical picture with or without fluid, and the physical signs are equally deceptive. In these cases the roentgen-ray examination, in conjunction with aspiration, would be of material assistance in clearing the situation.

The experience of the writer has been limited to cases of from three to six months' standing, but he has every reason to believe that accumulations of fluid in the pleural cavity occur in this infection as in the postpneumonic cases, except that they are more rapid in formation. In a communication read before this Society at its annual meeting held in Chicago in 1916, attention was called to the fact that early pleural effusions appear in the axillary space, climbing up between the parietal and visceral pleura until the apex is reached. They may be detected roentgenographically as a ribbon-like shadow of increased density, with a sharp inner border appearing in the outer zone of the chest, and as the fluid increases, this shadow increases in width and extends down to the diaphragm. At this stage there is an area of clear lung between the edge of the fluid and the root; not until the increase in this shadow reaches the outer edge of the inner zone does it tend to accumulate at the base. Finally, the effusion extends upward in the inner zone producing the character-

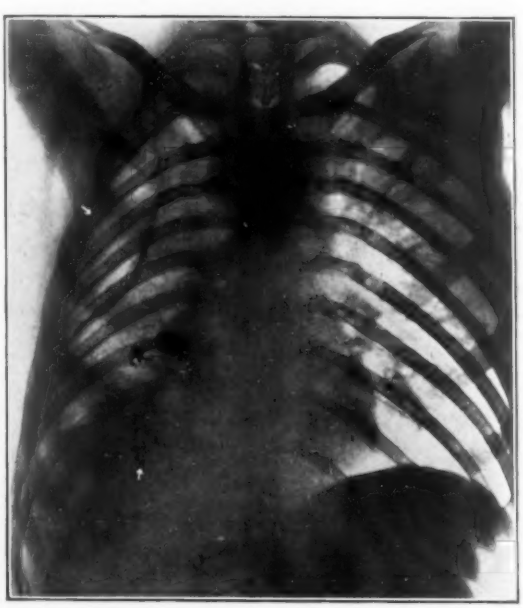

FIG. 4. SACCULATED PERSISTENT PNEUMOTHORAX ABOVE AN OLD DRAINING LEFT EMPYEMIC CAVITY. RETAINED PARTICLES OF BIP.

istic cup-shaped upper border. This peculiar roentgen finding continues until the effusion is nearly complete, when the entire side is filled with a dense shadow so that, at this time only, is there a distinct displacement of the mediastinal contents to the opposite side.

With a thorough appreciation of these facts, there is no reason why any difficulty should exist, at this stage of the disease, in ascertaining the presence or absence of fluid roentgenographically. Even positive findings should always be confirmed by a diagnostic aspiration.

It is the opinion of the Empyema Commission, headed by Major Edward K. Dunham, that this class of cases should not be operated until the effusion has become frankly purulent and the patient has recovered from the pulmonary lesion; exception is made only in cases of acute pneumothorax, when surgical measures are urgent. Lung pressure symptoms and displacement of the heart are meanwhile relieved by aspiration. The number and frequency of chest aspirations is determined by the rapidity of the reaccumulation of the fluid.

The improvement in the lung condition and the change in the character of the fluid occur as a rule in from two to three weeks, by which time adhesions have had an opportunity to form. This prevents a complete collapse of the lung when the pleura is opened. In addition, the patient is in a much more favorable condition to withstand the surgical procedure.

It has been the experience of most men familiar with streptococcus empyema, that in this infection the pleural thickening and formation of adhesions are much more extensive than in cases due to other infections. This very excessiveness of adhesions may have resulted in a sacculation of the fluid, so that it is essential before operating that the surgeon should have as accurate a localization of the exudate as is possible. This can be accomplished only by a thorough fluoroscopic combined with a stereoroentgenographic examination, confirmed by aspiration. This examination as a rule should be made on the day of the contemplated thoracotomy.

As soon as the pus is evacuated the Commission recommends the immediate institution of the Dakin treatment. For the first few days a simple suction apparatus is applied which permits of a frequent irrigation of the empyemic cavity with Dakin solution, as well as providing free drainage. As soon as the patient is able to be up and around, he is dressed daily, at which time fresh Carrel tubes are reinserted. In isolated instances it has been found convenient to control the position of the tubes by the roentgen-ray.

The daily dressing and the frequent instillation of Dakin solution is continued until the cavity becomes sterile, the case being constantly under bacteriological control. During the entire period special attention is paid to the patient's nutrition, his excessive nitrogen output being balanced by food, giving a daily value of at least 3300 to 3600 calories.

While the Dakin treatment is carried on, every effort is made to assist in the expansion of the lung by such auxiliary measures as the use of blowing bottles, mild exercises, etc.; so that in most cases, by the time the cavity has been made sterile, the visceral pleura has become adherent to the parietal layer, obliterating the cavity; the small remaining sinus is then allowed to close. While the lung is expanding, frequent roentgen ray examinations should be made, preferably by the stereoscopic method, the roentgenograms acting as a permanent record of the favorable progress of the case.

In a certain percentage of patients, even after the empyemic cavity has become sterile, the lung fails to expand completely on account of pleural thickening and adhesions, leaving a cavity of varying size; these cavities require continued Dakinizing, until it becomes evident that a permanent closure can be accomplished only by further operative measures. Valuable information as to the existing conditions in

these cases can be given to the surgeon by the roentgen ray examination.

Stereoroentgenographic examination after the injection of some substance opaque to the roentgen-ray has been found to be of value in certain cases with large cavities complicated by auxiliary sacculations, and which, on account of their peculiar configuration, are notoriously difficult to sterilize.

The persistence of small draining cavities or sinuses, even after they have been rendered sterile, is one of the most trouble-

FIG. 5. OLD RIGHT EMPYEMA. DRAINAGE WOUND HEALED THREE MONTHS. RE-ACCUMULATION OF FLUID. PLEURAL THICKENING.

some problems the surgeon has to deal with. It is due to the following:

1. Sequestration of the rib.
2. The formation of a fibrous or bony wall around the sinus.
3. Too long retention of the drainage tube.
4. Imperfect drainage.
5. The presence of a pleuropulmonary fistula.
6. A rigid-walled cavity which prevents the expansion of the lung.
7. The presence of foreign bodies.

The roentgen ray examination, both with and without injection, should be resorted to before surgical measures are undertaken; in many cases the cause for this nonhealing can be ascertained.

There remains for consideration that important group of cases which have been allowed to heal prematurely and which have either a reaccumulation of the pus at the site of the former empyema, or in a new location. It may be within the substance of the lung. In those cases the pleura is great-

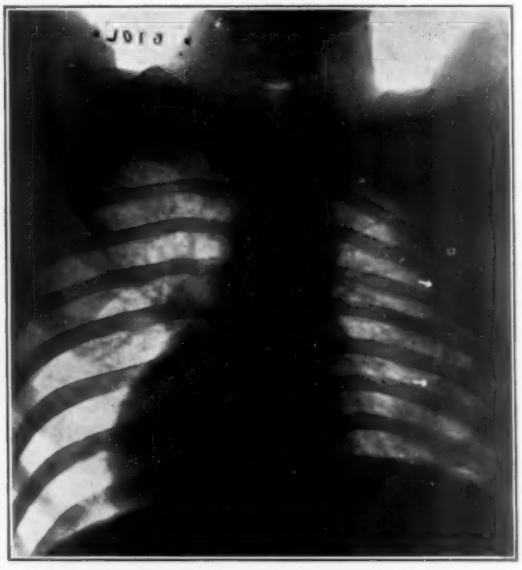

FIG. 6. SAME CASE AS NO. 5 AFTER ASPIRATION. 100 C.C. OF CLEAR STERILE FLUID REMOVED. NOTE THE DIFFERENCE IN DENSITY TO THE SHADOW AFTER ASPIRATION.

ly thickened, sometimes to over an inch, which renders an exact differentiation of these conditions extremely difficult.

We have also observed a number of patients with a persistent pneumothorax enclosed within a dense fibrous wall after the healing of the thoracotomy wound. Such cavities occasionally become filled with an exudate, the discovery of which is rendered difficult because the density of the fluid contents is similar to the thickened pleura. We have arrived at the conclusion that we can do little more than call attention to the shadows seen, and state

the various possibilities; the aspirating needle finally clears the diagnosis. If repeated aspirations are also negative, providing time will permit, careful and repeated roentgen ray examinations may in a certain number of cases clear the uncertainty. Pleural effusions, no matter how small, seldom remain stationary; even in old cases they usually increase slowly, so that there is a steady change in the contour of the shadows. On the other hand, pleuritic thickenings alone have a tendency toward slow but progressive diminution. If the case has been under observation before the reaccumulation has occurred, comparison with previous roentgenograms may assist in arriving at a diagnosis.

Special attention should be paid to the site of the old sinus tracts which are particularly favored locations for reaccumulations of fluid.

Similar difficulties are encountered in the roentgen ray examinations of cases which have never been operated and which were treated merely by aspiration.

In general it may be stated that the shadow of pleuritic thickening alone is rather more clear cut in detail than when fluid is present, as the latter produces a certain amount of haziness.

Unless there is a specific contra-indication all draining cases should be examined from time to time roentgenographically.

FIG. 8. OLD HEALED LEFT EMPYEMA. REACCUMULATION OF FLUID AT SITE OF FORMER DRAINAGE WOUND. CLEAR STERILE FLUID ASPIRATED. DIAPHRAGM CAUGHT UP IN PLEURITIC ADHESIONS.

FIG. 7. OLD RIGHT EMPYEMA. DRAINAGE WOUND HEALED THREE MONTHS. OPERATIVE FINDINGS: PLEURAL ABSCESS CONTAINING ABOUT 10 C.C. OF PUS WITH THE SURROUNDING PLEURA ABOUT ONE INCH THICK.

It is preferable that this examination shall be complete, i.e., by fluoroscopy and by stereoroentgenography. If the information obtained is not satisfactory, the examination is repeated by the same methods after injecting the cavity with a solution or paste containing a substance opaque to the roentgen-ray.

In my experience, bismuth pastes are the most satisfactory for the following reasons:

1. Pastes when properly warmed can be readily injected into the cavities.
2. Pastes are retained without difficulty when slightly cooled.
3. Fluoroscopic examinations in any position can be readily made without the risk of an escape of the injected mass.
4. A clear detail of the sinus as well as the cavity is obtained.
5. The pastes are non-irritating.

6. A possible therapeutic effect may also be considered, although the writer has thus far failed to detect any notable benefit. One has but to see the rigid walls of the sinus and cavities on the operating table to appreciate that surgery alone can achieve a cure. Two or three cases of small sinuses healed after the injection, but we are of the opinion that they came under the class of too long retention of the drainage tube and that it was the removal of it that permitted a closure of the sinus.

FIG. 9. OLD RIGID WALLED RIGHT EMPYEMIC CAVITY. INJECTED WITH BISMUTH PASTE.

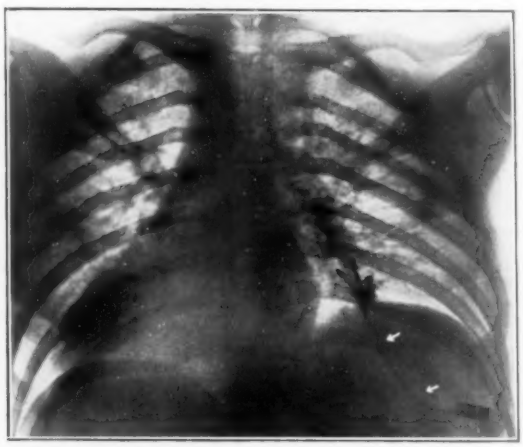

FIG. 10. OLD RIGID WALLED SINUS REMAINING AFTER A RIGHT EMPYEMA. INJECTED WITH BISMUTH PASTE. NOTE DETAIL OF CAVITY AS WELL AS TRACT OF SINUS. OPERATIVE FINDINGS SHOWED PECULIAR CONFIGURATION OF THE CAVITY DUE TO SMALL PROLONGATIONS EXTENDING OUT INTO THE THICKENED PLEURA.

The objections to the use of bismuth pastes may be classified as follows:

1. The danger of poisoning by absorption.

It was appreciated at once that there was a possibility of poisoning when large cavities were filled with the paste. The writer has frequently used bismuth subnitrate in paste form as high as 33 per cent without deleterious results. Proper attention should always be paid, however, to the selection of a pure drug. Most reported cases of intoxication have been due to the presence of nitrites.

2. The danger of reinfecting a sterile cavity.

There is no valid reason why bismuth pastes cannot be sterilized, and when injected with proper aseptic precautions, the danger of reinfection of the cavity is negligible.

3. The difficulty of removal.

This is no doubt one of the principal disadvantages of pastes. In a measure it can be overcome by washing out the cavity with warm sweet oil.

4. The possibility of the paste obstructing the tube and interfering with drainage.

This is a justifiable objection. The knowledge of this possibility, however, will, as a rule, prevent any serious results. The dressings should be carefully watched for a cessation of the drainage; the temperature should be frequently taken, as a sudden rise would indicate retention; and appropriate measures should be taken to combat it. The difficulties met with are almost entirely limited to large cavities; after some trial, the bismuth paste was discontinued in these cases. Small cavities and sinuses, especially if there was a free opening, never gave any trouble, and were most satisfactorily outlined by the paste.

Mixtures of varying strength were tried; but it soon became evident that if a paste was to be used at all, it must be of sufficiently high density to accomplish the

object desired, namely, to outline clearly the entire sinus and cavity.

After considerable experimental work it was decided to use a paste made up as follows:

Bismuth subnitrate	25	per cent
Vaseline	73	" "
Wax	2	" "

This mixture has been most successful in the writer's hands.

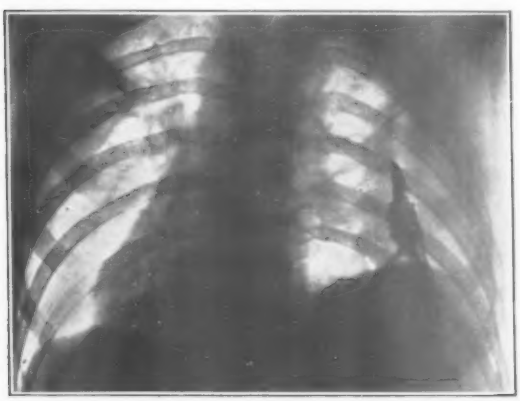

FIG. 11. OLD RIGHT EMPYEMIC CAVITY. DIFFICULT TO RENDER STERILE ON ACCOUNT OF PROLONGATIONS. INJECTED WITH BISMUTH PASTE.

The use of bismuth subnitrate was not a matter of choice; it was used because no other salt of bismuth was available. Bismuth subcarbonate or oxychloride will give the same satisfactory density to the shadows without the danger of poisoning.

There is one condition in which it is impossible to use anything but bismuth paste, namely, the presence of a bronchial or pleuropulmonary fistula. Our experience has been limited to seven cases; out of this number we have been able accurately to demonstrate this condition in six. The positive evidence is convincing, the negative is of little value. Solutions in contradistinction to pastes are rather dangerous in these cases, as they produce spasm and severe coughing, which last for a considerable period of time.

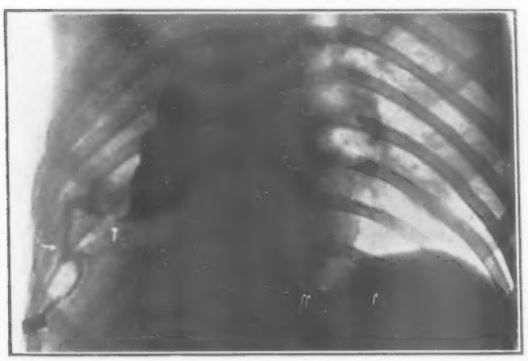

FIG. 12. OLD PERSISTENT SINUS FROM A LEFT EMPYEMIC CAVITY WITH IMPERFECT DRAINAGE. INJECTED WITH BISMUTH PASTE. NOTE DETAIL OF SINUS.

As the use of bismuth paste was objectionable in large cavities, we were forced to take recourse to other substances. We mention particularly the following:

1. On account of their comparative cheapness, solutions of iodide of potassium or sodium in varying strengths were tried. It was found that 20 per cent solutions of these salts gave satisfactory shadows. Unfortunately, they were found to be too irritating; the patients complained of pain and had severe respiratory spasm and cyanosis; so severe were these symptoms in some cases, that the use of these solutions was discontinued.

FIG. 13. OLD PERSISTENT SINUS FROM A RIGHT EMPYEMIC CAVITY. RETAINED DRAINAGE TUBE. INJECTED WITH BISMUTH PASTE.

2. The most satisfactory, and the one now generally used, is a 15 per cent neutral solution of thorium nitrate. It is quite

expensive, especially when used in quantities sufficient to fill large cavities, but is much less irritating than the iodides, although in two cases quite a severe hemorrhage followed its use. It has the advantage of being a clear watery solution, which

FIG. 14. DRAINING RIGHT EMPYEMA WITH PLEURO-PULMONARY FISTULA. INJECTED WITH BISMUTH PASTE.

can be readily washed out, and does not in any way interfere with drainage, or the continuance of the Carrel-Dakin treatment. We believe, however, that any injection into large cavities should be avoided, if possible.

FIG. 15. OLD DISCHARGING SINUS FOLLOWING THORACOTOMY FOR RIGHT EMPYEMA. INJECTED WITH BISMUTH PASTE SINUS COMMUNICATED WITH A BRONCHUS THROUGH A PLEURO-PULMONARY FISTULA.

In complicated cavities of considerable size the patient is placed on the table in such a position that the opening into the chest is uppermost. The requisite amount of thorium solution is now slowly injected with a blunt-pointed glass syringe of about 30 cc. capacity. The patient should be

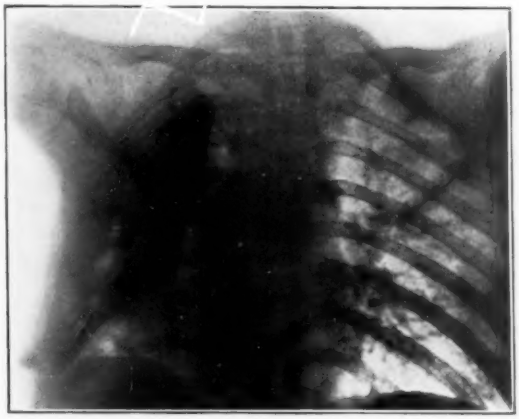

FIG. 16. LARGE LEFT EMPYEMIC CAVITY. INJECTED WITH A 15% SOLUTION OF THORIUM NITRATE.

warned not to make any unusual respiratory effort, as quiet and shallow breathing gives the best results, permitting a perfect filling of the cavity.

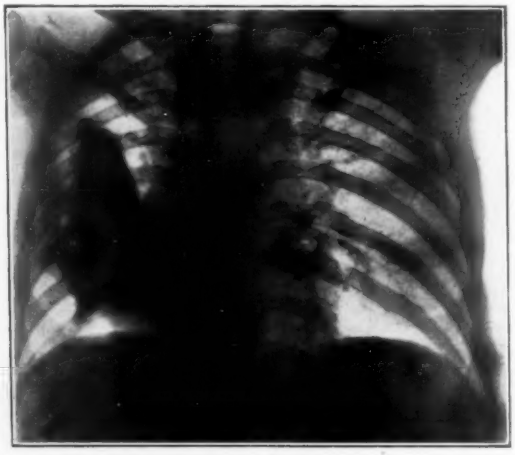

FIG. 17. LARGE RIGID WALL LEFT EMPYEMIC CAVITY OUTLINED BY INJECTING A 20% SOLUTION OF POTASSIUM IODID.

In the use of watery solutions, some difficulty arises from the fact that it is not easy to close the opening in such a manner that the fluid does not escape when the

patient is placed in proper position for the roentgen ray examination. We have found the best plan was to plug the opening firmly with a generous piece of sterile gauze

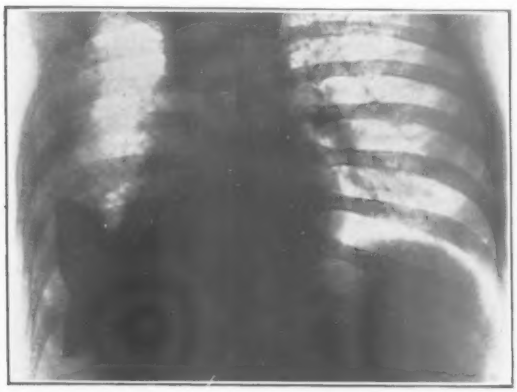

FIG. 18. OLD LEFT EMPYEMIC CAVITY INJECTED WITH A 20% SOLUTION OF BISMUTH SUBCARBONATE IN SWEET OIL.

packing, covered with a piece of rubber dam; this dam is firmly strapped down with wide adhesive strips at its edges, and a lead marker attached to an adhesive strip is placed over the wound.

Even with these precautions, there is always some escape of fluid, so that fluoroscopy after the plates are made is often unsatisfactory, as leakage produces adventitious shadows.

When dealing with small cavities or sinuses, the same technique is employed, except that the sterilized bismuth paste is substituted for the thorium solution. A graduated glass syringe is used to measure the quantity injected. The appropriate amount of paste required for each case is sterilized in separate receptacles, so that there is no danger of contamination from one case to another. After the injection, one can safely complete the entire examination, including fluoroscopy in all positions without danger of escape of the paste.

If a bronchial fistula be suspected, unusual care should be exercised in introducing the paste. The injection must be made very slowly, frequent inquiries being made of the patient as to whether he feels like coughing or whether he tastes the injected material. An attack of coughing, while not harmful, may clear the bronchi of the paste, and the very detail we are desirous of obtaining may be lost. After the completion of the examination, the cases should be immediately sent to the surgeon for proper dressing.

ADDENDUM

Owing to the difficulty of obtaining thorium solutions, the author, at the suggestion of Lieutenant Stevens, substituted a 20 per cent. solution of subcarbonate of bismuth in sweet oil, or liquid albolene. This was found very satisfactory for outlining cavities of moderate size, especially those with small external openings. In cases of small cavities with generous openings, the sweet oil solution has no special advantage; it does not give the detail that is obtained after using bismuth paste, providing the paste be thoroughly liquefied before injection. The oily solutions have the same objections as those of thorium, namely, that the opening must be tightly sealed after the injection in order that there may be no leakage when the patient is examined fluoroscopically in the erect position, a very necessary procedure. Some of the important advantages of its use over the paste are that it can be readily removed and does not interfere with drainage—two points which certainly appeal to the surgeon. Proper judgment should be used in each individual case in the selection of the opaque substance to be injected.

All cases where bismuth in any form is used should have a generous drainage opening and care should be taken to remove as much of the injected material as possible after the examination is completed. Retention of bismuth injections renders the patient liable to poisoning, as occurred in one case where a 20 per cent. solution of bismuth subcarbonate in sweet oil was used.

The author wishes to express his appreciation of the aid given by Major A. V. Moskowitz in the preparation of this paper.

SOME NON-TUBERCULAR PULMONARY CONDITIONS*

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THE object of this brief paper is to call the attention to certain more or less definite conditions observed in a considerable number of cases which have been referred for roentgen examination of the chest. Usually a provisional diagnosis of tuberculosis has been made, but in most instances there has been an absence of the complete clinical picture of tubercular involvement, or at least some diagnostic factor is at variance with the rest of the findings.

In the cases examined there has usually been a history of grip, tonsillitis, or even pneumonia of a mild type. Following the acute attack there persists an evening temperature, a rapid pulse rate, extreme weakness, continued loss of weight and a failure to return to normal, despite an absence of any definite indications of the true location of the cause. There may be very little cough or expectoration, and physical examination may reveal only a few moist râles, slight tubular breathing or impaired resonance, or these may all be entirely undistinguishable. The sputum, when present, will usually show pneumococci, staphylococci, and streptococci or influenza bacilli. These organisms are not diagnostic and hence offer little value in localizing the disease. There is apt to be a polynuclear leucocytosis, though in one of the cases here reported there was, at times, an absence of polynuclear increase.

Stereoscopic plates will usually show a thickening about the hilum, which extends along the main bronchial branches. The process, involving the smaller branches, gives to the lobe a coarsely striated appearance, the striæ radiating from the hilum but markedly different from the delicate fan-shaped areas sometimes seen in early tubercular involvement. There is also more or less interstitial infiltration or congestion giving to the area the appearance of a general increase in density through which may be seen the thickened bronchial tree.

The condition may be distinguished from:

1. Abscess, by the absence of a localized area of great density or the usual appearance of a fluid level in the upright or lateral position with a gas area above.

2. Lobar pneumonia, by an absence of the dense consolidation of the interstitial lung tissue without the appearances of abscess.

3. Lobular pneumonia, by the absence of discrete areas of lobular consolidation.

4. Tuberculosis, by the absence of tubercles or of the characteristic tubercular mottling.

From observing the course of the cases that he has had the opportunity to follow, the writer is convinced that the condition is a low grade of bronchitis and peribronchitis due to pyogenic organisms or, in a more developed form, a type of septic bronchopneumonia, which may run a subacute course for several months and terminate in complete recovery, or may proceed to abscess formation requiring surgical intervention to effect a cure.

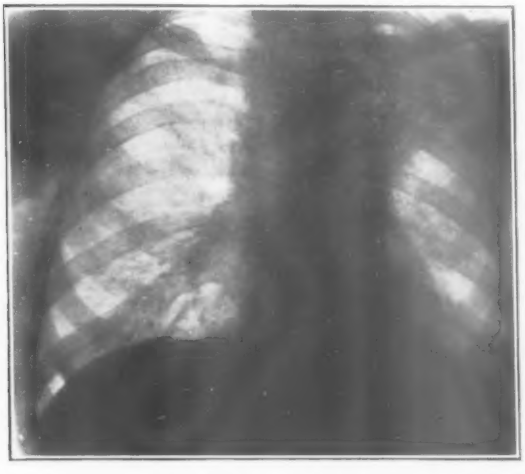
Illustrating the conditions, or different phases of the same condition, four cases are reported as follows:

CASE 1.—Mrs. K., white, female, age 67, presented the following history: The latter part of January, 1918, had an attack of lobar pleuropneumonia in the lower right lobe which ran a typical course with beginning resolution on the eighth day. At this time the lower left lobe experienced a similar typical attack. Following this a migratory pneumonia continued to involve

* Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Camp Greenleaf, Ga., September, 1918.

the left side. There was no crisis, but her elevation of temperature continued and on the 19th of April, 1918, a roentgen examination of her chest was made. A blood count at this time showed a lymphocytosis of sixty-eight per cent, polynuclears, twenty-four per cent. A sputum examination revealed staphylococci, pneumococci and influenza bacilli.

Roentgen-ray Report. — "Right Lung shows fine striations along descending



No. 1. Case 1. Mrs. K.

bronchial branches from hilum downward. There is a considerable fan-shaped area surrounding the hilum that is not sufficiently homogeneous for abscess but appears to accompany the bronchial tree. The upper left lobe shows a similar and more completely consolidated area but is striated and not evenly consolidated."

Conclusion.—"The condition is apparently not an abscess but an inflammatory bronchial and peribronchial process, probably a bronchopneumonia confined to these lobes, but not involving the parenchyma of the lung to a marked degree. There is also a considerable mediastinitis."

Case 2. C. B., white, male, age 12. Admitted to hospital April 14, 1918, following a paracentesis for otitis media. His ear steadily improved and his temperature receded, but continued to fluctuate from normal to 100° F. and occasionally to 101° F. His blood count showed a leucocytosis ranging between 16,000 and 29,000 with polynuclear percentages of 76 to 92. No physical signs could be elicited.

Stereoroentgen examination on the 7th of May was reported as follows: "Patient has marked pleural thickening over right upper lobe. Linear tubal thickening and interstitial infiltration of apex above the clavicle."

No. 2. Case 2. C. B.

Conclusion.—"Condition is probably an inflammatory consolidation with no distinct abscess present."

This case progressed to complete recovery without operation.

Case 3.—D. K. J., white, male, age 38. History of tonsillectomy two weeks before on account of supposed pulmonary infection and pain in right foot, attributed to absorption from tonsils. Had previously had night sweats which persisted for a time, disappeared and returned after five months. Since tonsillectomy, patient has grown steadily weaker with increased

pulmonary symptoms. The left lung was found on physical examination to show higher pitched breathing in the upper lobe "as though compressed at the hilum." Blood examination showed polynuclears 86 per cent. Sputum examination showed absence of tubercle bacilli, but staphylococci, chains of diplococci and pneumococci abundant. He was referred on May 21, 1918, for roentgen-ray examination of bones of leg and for stereoscopic examination of the chest.

Roentgen-ray Report.—"Bones of the leg show no lesion."

No. 3. Case 3. D. K. J.

Chest.—"Diaphragm on right and left about the same height, surfaces smooth."

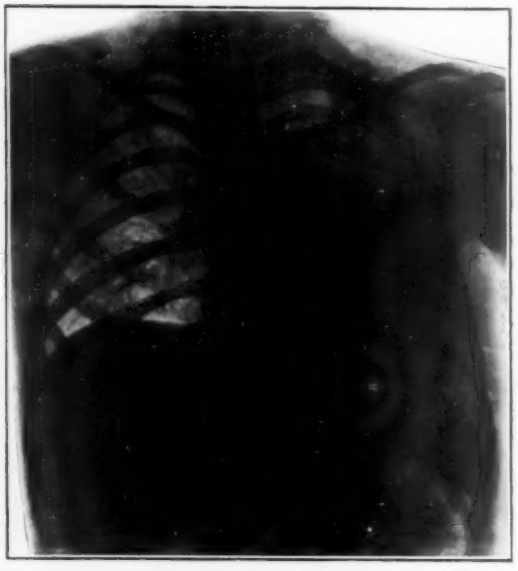
Right Lung.—"There is a greatly increased amount of connective tissue about the hilum and a dense area extends upward, broadening as it ascends, obscuring entire right apex. The descending bronchial branches are also thickened. Considerable fine studding is seen in the base of the upper lobe and upward to the dense area mentioned above."

Left Lung.—"There appears to be a large, soft gland at the hilum and a very slight studding outward from the hilum."

Conclusion.—"Patient has a slight recent tubercular infection chiefly in the base of the upper right lobe, but to some extent in the left. The dense area described is an inflammatory thickening of the mediastinal pleura and that over the apex. It is possible that there is a pus area within this thickening but the shadow is too dense to distinguish the condition within it."

The patient died August 8, 1918.

Case 4.—A. J., white, female, age 5. Admitted to hospital March 5, 1918.



No. 4. Case 4. A. J.

Operation March 8, diagnosis subacute appendicitis. Temperature increased the day after operation and continued high with slight remissions for ten days thereafter when she was referred for roentgen examination of chest and left hypochondrium for abscess. The report is as follows:

"Patient has a complete consolidation of the lower left lobe. Condition appears to be pneumonia."

A second examination two days later

showed "Left lung clearing up very much. Still considerable deposit near the hilum."

A third examination eleven days after the first showed lung clear except for small dense glands and calcified tubercles about each hilum. Leucocytes 9,200, polynuclear 56 per cent. On the day of first roentgen examination, leucocytes 14,600, polynuclear 77 per cent.

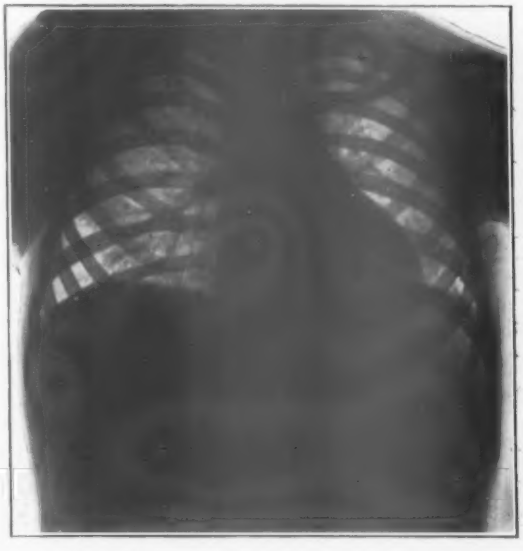
Upon examination of specimen, the pathologist reported: "Sections of appendix show no pathology."

Recovery was complete and uninterrupted.

This case seems to have been one of mistaken diagnosis and the child probably was not suffering from appendicitis, but from some form of intestinal toxemia. The pneumonia was the result of the anesthetic.

This last case is included for purposes of comparison and to show the roentgenographic records of the progress of the lobar type of pneumonia from its height to complete resolution.

No. 5. Case 4. A. J. 2 days after No. 4.



No. 6. Case 4. A. J. 11 days after No. 4.

EMPYEMA, ITS PATHOLOGY IN RELATION TO ROENTGEN-RAY EXAMINATIONS*†

BY ROBERT A. KEILTY

Major, M. C., U. S. A.

PHILADELPHIA, PA.

THE purpose of this paper is to discuss the pathology of empyema in so far as it relates to the roentgenologist.

The word *empyema*, by general usage, has come to be applied loosely, too much so from the strict pathological sense. We are being reminded constantly by our surgical friends that their methods are based upon pathological principles. Let us not in the rush and enthusiasm of war work get away from these principles which have been founded upon years of keen observation. I have frequently heard men discussing empyema very broadly, and making a point of the fact that the cases encountered during the past winter's epidemic were of a different type and varied in the pathology from those that they were accustomed to see during civil practice. From my own experience, in autopsies of more than a year at this hospital, I cannot see that there has been any variance whatsoever from well established findings. There has been, however, an increase in the number of cases, interest centered around them, and facts which had probably been lost sight of were surrounded by an undue importance. The terms *empyema*, *pleurisy*, and *pleuritis* are not definitely established in the minds of most clinicians, and this is, I think, one of the major reasons for the variance of opinion.

Pleurisy should be dropped from the nomenclature entirely. It is a poor synonym for pleuritis, which is a better term and can be more definitely subdivided. Empyema of the pleural cavity is a pleuritis, but a pleuritis is not necessarily an empyema. The term empyema should be restricted to those cases which have a definite localized and walled-off collection or collections of pus in the pleural cavity. Empyema would be defined, then, as an accumulation of pus confined within the pleural cavity. By pus, I mean pus cells, débris of exudate and transudate, infecting bacteria, products of lytic and enzymic action and fats. Empyema is thus reserved for a definite class of cases and does not include any other type of inflammatory exudate. The term *pleuritis* includes all types of inflammatory processes of the pleura and is classified as follows: Pleuritis, acute and chronic: the acute is subdivided into fibrinous, serofibrinous, and purulent. Empyema is a type of the latter. There may be accumulations within the chest of several different types of inflammatory fluids which are not empyematous. If this fact is borne in mind, much confusion will be eliminated.

The typical case of empyema occurs late in the chest development and has had a chain of pathological forerunners. It cannot be denied that occasionally a case may be primarily an empyema, but this is very rare and is usually in association with the polyserositis group. The usual history begins either with sore throat or bronchitis, often exanthemata, and has as its portal of entry the upper respiratory tract. The disease extends as a direct respiratory disease, becoming rapidly either a pneumonia of the lobar type or more gradually a lobular or bronchopneumonia. The pleura, involved as a part of the general reaction, is always of the exudative type at first, that is, fibrin and fluid with few cells. The pleuritic area is usually uniformly affected.

In the lobar pneumonias, the expansion of the lung, by its exudate from within, forces it against the side of the chest and the plastering and sticky character of the

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exudate holds it there. This mechanical force influences, to a great extent, the position of the empyema developing secondarily. As a principle, fluid gravitates to dependent positions. In the chest, with the patient in the recumbent position, there are two levels for fluid collection in the presence of a fibrinous exudate. The one is posteriorly against the parietal pleura and at the base of the complemental space, and the other is anteriorly over the lung and beneath the sternum. The latter position is made possible for an accumulation by the fact that the fibrin has plastered the lung against the chest wall laterally. This is probably truer on the left side—where the influence of the heart is felt—than on the right side.

The collections are always greater in amount posteriorly than anteriorly. They are more likely to be posteriorly in one large area, while anteriorly they tend to collect in numerous smaller ones. The interlobar collections may occur at any position, again very often dependent upon the plastering of the exudate. From my own experience, the latter group of cases has been quite uncommon and present only in small collections. From this experience, I cannot help but feel that when the diagnosis is made so frequently, clinically and by roentgen-ray plates, there must have been some mistake in the interpretation of an intralobar condition.

In the bronchopneumonias the increase in the size of the lung is not so marked and thus the force from within does not hold the lung out against the chest wall as in the case of the lobar type. In these cases the collections are more definitely posterior and even lateral, but not so likely to be anterior. Here the pressure of the fluid is felt against the lung and the latter is likely to be pressed against the median line.

In the development of empyemata the change taking place in the exudate from a false membrane type to a suppurative one may be brought about in different ways. These exudates are primarily of pneumococcic or streptococcic origin, or both. These organisms do not call out pus cells in their first reactions but rather the serofibrinous character of exudate. Such exudates, being acute, cannot remain as such, but must either be removed or organized. The process of removal is responsible for a migration of leucocytes, which in turn changes the character of the exudate to a fibrous one; thus the products of pus are walled off by a permanent structure of fibrous tissue, which obliterates that part of the pleural cavity involved. This process ordinarily takes from two to three weeks and it is at this point that true empyema may be said to exist. The invasion by secondary pyogenic organisms may in addition change the character of the exudate from a fibrinous to a purulent one and thus be responsible for empyema. In lobular pneumonia when the entire cavity is filled with pus the fibrosis takes place in the pleural covering of the lung; in its contraction it helps in the reduction and atelectasis of the lung, which in the end may be flattened against its hilus, literally like a pancake. Such a collection is liable, by pressure, to extend well over beyond the midline to the opposite side.

SUMMARY

The problem of empyemata as it relates to the roentgenologist has to do with diagnosis.

The types of cases and their classification must be definitely understood, else the conclusion will be misleading.

The streptococcus and pneumococcus are primarily responsible for most of the cases with pyogenic organisms as secondary invaders.

This being the case, the early manifestations of pleuritic involvement belong to the pleuritis acute group and are characterized by serofibrinous types of exudates. The amount of fluid which accumulates is not very great as a rule.

The changes in the character of the exudate from a fibrinous to a purulent one are accompanied by equal changes in the nature of a wall in other parts of the

exudate, whereby the fibrin is organized into fibrous tissue.

I should like to lay stress upon these changes and advise the more frequent use of the roentgen-ray laboratory from day to day. I have, on several occasions, seen roentgen-ray reports at autopsy which were quoted and which had been made several days prior to death. The conditions then found were entirely different from those found by roentgen-ray examination. This was not due to faulty plate interpretation but to changes in conditions. With these exudative changes it is not so much a matter of hours but of days, and as a working rule I should advise repeated examinations every three days. In this way, a large number of cases studied over a period of perhaps five weeks, from the beginning of pleuritic signs to the definite walling off of an empyema, would be most instructive.

ROENTGENOLOGY AS A METHOD OF STUDYING THE NATURAL HISTORY OF DISEASE*

The author wishes to express his appreciation for the inspiration and material help in the preparation of this article which he received from Major Dudley D. Roberts and for the hearty coöperation of the other members of the staff at General Hospital No. 1, especially Major Edward G. Cary and his associates, in the pathological study of cases and specimens.

BY LEWIS GREGORY COLE

Major, M. C., U. S. A.

THE roentgenogram is a record of the varying densities of normal and pathological tissues. The value of the roentgenogram is directly in proportion to the accuracy with which the roentgenologist interprets pathological lesions from these varying densities. The accuracy with which this is done is directly dependent on the breadth and depth of the roentgenologist's knowledge of pathology. In bygone days the pathologist was an artist who could cut the thinnest sections by hand with a razor. The microtome changed that, and he became a scientist who studied the sections and interpreted his findings in terms of disease (pathology). In more recent days the roentgenologist was the artist who, with a gas tube, coil and some kind of interrupter, could make the clearest roentgenograms. With the advent of the Coolidge tube, roentgenography ceased to be an art and became a simple mechanical procedure.

Like pathology, roentgenology has become the science of the study of diseased tissues, and the interpretation of the findings in terms of pathology, not necessarily of etiology.

That there may be no misunderstanding we will clearly define what is meant by "roentgen findings" and how they differ from "roentgen diagnosis."

The term "roentgen findings" is applied to varying densities of the plate caused by the interposition of normal or diseased tissue. Such terms as filling defects of the stomach, cloudiness of the left apex, or an increased density over the right lower thorax, are simply descriptions of varying densities of the plate and are not expressions of pathology.

The "roentgen diagnosis" is a man's personal interpretation of the roentgen findings in pathological, but not necessarily etiological terms. Eastmond has compared it with two physicians listening to the same chest; both heard the same sounds or detected the same findings, but one interprets the physical signs as pneumonia, and the other as pleurisy with effusion.

The physician is a good or poor diagnostician according to his ability to interpret the physical signs in terms of pathology; likewise the roentgenologist is good or poor according to his ability to interpret correctly the roentgen findings in terms of pathology.

It may be wise to describe the roentgen

* Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Chattanooga, Tenn., Sept. 1918. Published by authority of the Office of the Surgeon General.

findings thus: "There is a smooth homogeeous shadow involving the lower part of the right thorax gradually curving up from the dome of the diaphragm and running parallel with the chest wall."

The roentgenologist should be better qualified to interpret those findings into a roentgen diagnosis than the physician would be to whom such a report is made. The roentgen diagnosis would be pleurisy with effusion or a non-sacculated empyema. The clinical history, or even a thoracentesis, might be necessary to differentiate between certain conditions; but, again, let me protest against the roentgenologist making the roentgen diagnosis on the clinical history.

The service is offering a wonderful opportunity for the comparative study of roentgenology and pathology, to the advantage of the roentgenologist; and is stimulating a more thorough necropsy, especially in a search for the tissues which cause unusual roentgen findings. If the roentgenologist is to become more than a technician he must have a thorough knowledge of pathology. While acknowledging my own limited knowledge of pathology, I still maintain that pathology is the foundation on which roentgenology must be built, and I also have a vision of roentgenology contributing more materially to pathology.

Routine necropsies in the past failed absolutely to reveal the frequency and importance of certain pathological processes until they were demonstrated on the operating table. I refer particularly to postpyloric ulcers. We may, therefore, contend that pathology is by no means a finished book, and that there are diseases of many parts of the body open to further elucidation by other than a study of dead tissue.

The term "living pathology" has been usurped by the surgeon, but the roentgenologist may also lay claim to this method of examination. Roentgenology gives a clearcut idea of deviations from normal without the distortion that is incident to the removal of the parts at the time of necropsy. The removal of the lungs breaks up the adhesions and destroys the pockets, which are most important in the study of the "natural history" or clinical course of an empyema. Roentgenology combined with pathology is the method *par excellence* for the study of the natural history of certain pathological processes, particularly those of bones, lungs and certain parts of the gastro-intestinal tract. The works of Fennister on bones and Miller and Dunham on the lungs, are brilliant examples of this method of observation.

The limitation of pathology compared with roentgenology as a method of studying the natural history of disease is the *crux* of this communication.

Gross pathology in an individual case is limited to the study of the process at a single stage of its development, usually a late stage. The progress of the pathological process has been deduced from the study of a large number of cases dying at different stages of the disease. Therefore the natural history of the pathological process has been determined by a series of autopsies on similar cases, together with the clinical history of the patient.

This is like writing the history of a people by noting the racial characteristics of a great number of individuals. It is valuable and essential, but far less interesting than the life history of the country's great characters.

After it has been established by a comparative roentgen and pathological examination that a certain pathological process causes characteristic roentgen findings, the course or natural history of that pathological process may best be studied by a series of roentgenograms of an individual case made during the course of the disease —a biography, as it were, of an individual case.

The service has offered an exceptional opportunity for this method of study, and the object of the present communication is to stimulate its adoption by the members of this Society.

There are many moot questions and un-

solved problems in which periodical roentgenological examinations will be of inestimable value in the study of disease. The question of malignancy being engrafted on gastric ulcers is an example of the former, and the progress and resolution of pneumonia and the development and progress of empyema are examples of the latter.

McCarthy, of the Mayo Clinic, maintains that a large percentage of gastric cancers are engrafted on gastric ulcers. Ewing and Mallory and many other pathologists have failed to confirm this, and believe that only from two to six per cent are engrafted on gastric ulcers. It has been established that small gastric ulcers cause characteristic roentgen findings. McCarthy says that many of these small ulcers have pathological manifestations of malignancy, provided a sufficiently high-powered microscope is used; Ewing, Mallory and others maintain that the arrangement of the cells on which McCarthy bases his diagnosis of malignancy is not sufficient evidence to justify such a diagnosis. Therefore this is a most important moot question which it has been very difficult to decide.

If the ulcer is excised and examined microscopically, one pathologist will report it as malignant, and the subsequent history of the case may show that according to his opinion the case was one of gastric cancer cured by excision; while the other pathologist will report it as a case of simple ulcer, and subsequent history may show an ulcer cured by excision. This type of ulcer is readily recognized by roentgenological findings, and in my own experience I have definite evidence upon the question as to whether or not gastric ulcers frequently become malignant.

The onset, progress and resolution of pneumonia, the development of its sequelæ, particularly empyema, and the study of its course as evidenced by the fillings of pockets, recognized by periodical roentgenography and compared with the clinical history of the case, offer a remarkable field for the combined study of the roentgenologist and pathologist; and the service, particularly that part with which it has been my good fortune to be associated, has offered a remarkable opportunity for this method of study.

The following is a list of some of the pathological processes where a periodical roentgen examination is of practical value, not only in the study of the causes of the disease, but also as a factor in determining the method of treatment to be pursued, and whether or not surgical procedure is necessary:

(1) Pneumonia { Pneumococcus / Streptococcus }

(2) Empyema { General / Sacculated }

A. Diagnosis

B. Whether for surgical procedure

C. Location of incision

D. Location of accessory pockets if present

(3) Pleurisy with effusion

(4) Pulmonary tuberculosis

(5) Pericarditis

(6) Mastoiditis { Diagnosis and Progress } A. Before operation / B. After operation

(7) Sinusitis

DISCUSSION ON LUNGS

MAJOR LE WALD.—There is a point in differential diagnosis that really merits careful consideration. There are a number of cases recorded in the literature of operations for right-sided abdominal pain, supposed to indicate appendicitis, that turned out to be cases of pneumonia. I had a very early experience of that sort in an adult; and at the operation the condition was so striking that you might have said the appendix was really absent. There couldn't have been an acute appendicitis. There was a mere fibrous band of an atrophied appendix; and that case, on physical examination about four hours later, was found to have a well marked lobar pneumonia. The case went through the usual course and convalesced from his pneumonia. The pneumonia was present, or at least the initial phase was present, at the time the patient was operated on for the supposed appendicitis.

The point I wish to bring out is this: That was before it was customary to roentgenize cases of supposed pneumonia. Later on we had two cases in which there was typical right-sided pain with tenderness on pressure, and by roentgenographing these patients we were able to demonstrate a beginning pneumonia. We have records of these cases going on to a well-developed pneumonia, which resolved, and no operation was performed. That is, the roentgen-ray diagnosis differentiating between pneumonia and appendicitis is perfectly feasible and logical, and should never be omitted where it can be carried out.

In regard to Major Cole's case, the question of the demonstration of a heart shadow inside the pericardial effusion is new. We tried to carry out experiments on the cadaver to demonstrate the possibility of outlining the heart inside the simulated effusion, by injecting the pericardial cavity. We were not able to demonstrate that conclusively; and as far as I know, in the literature there has not been a differential diagnosis made in this way. Dr. Cole's demonstration seemed to be very conclusive on this point; and yet it is a matter of so much importance, and so much out of the ordinary experience of those who have attempted to demonstrate conclusively that one had a pericardial effusion by seeing the heart shadow inside an outer shadow which represents the fluid in the pericardial sac, that I should like to have some confirmatory discussion on that point.

DR. GEORGE W. HOLMES.—In the paper which Dr. Stewart has presented, some of the slides which were shown looked to me very much like pneumonias along with the empyema. I know that Dr. Stewart has proved his cases; and I would like him, if he will, in closing his discussion, to speak a little more fully of the differential diagnosis between a pneumonic patch in a lung which is compressed and the localized empyema which he has shown.

Dr. Stewart also spoke of the necessity of stereoscopic plates at all times. I agree with him that after operation and removal of the fluid it is necessary to have stereoscopic plates; but I have always felt that where there was simply fluid in the chest, a single plate, or even a fluoroscopic examination, was sometimes all that was necessary. It is a matter of considerable expense to take routine stereoscopic plates.

A thing which has interested me in these cases is the position of the diaphragm. Normally, the position of the diaphragm when the chest is open should be low. As soon as the negative pressure is removed in the chest the diaphragm goes down. In all the cases that Dr. Stewart has shown the diaphragm is high, which suggests, at least, that the diaphragm becomes adherent early and that this perhaps has something to do with the fact that the lung does not expand. If we attempt to get expansion of the lung by the usual methods while the diaphragm is fixed and high, the patient will simply produce an

emphysema in the other lung, because one cannot get air into a lung unless the diaphragm goes down. I would like to ask whether or not Dr. Stewart has had an opportunity to study any case where freeing of the diaphragm has been done.

The case of fluid in the pericardium which Dr. Cole showed is very interesting. I have for some time been particularly interested in this subject, and have gone over the literature fairly carefully. I have also had some experience with these cases, and I must agree with what Dr. Le Wald has said. I think before we accept the finding which Dr. Cole has described, we should have very conclusive proof; first, because it has never been done before, and a number of men have tried to demonstrate fluid in the pericardium in this way; and second, because it is rather against the physics of the thing. That is, there is no special reason why the heart, which is practically of the same density as the content of the pericardium, should show, unless there is air present.

Dr. Henry K. Pancoast.—I should like to support Cole. I was very much surprised to hear any adverse opinion in regard to the possibility of showing the shadow of the heart in a pericardial effusion. I am so certain of this that I have been in the habit of teaching it as one of the signs of pericardial effusion. When the effusion becomes of prodigious proportions, it is impossible to see the shadow of the heart. There seem to be very few signs in pericardial effusion. A sign upon which I have placed dependence as rather positive is the obliteration of the cardio-hepatic angle. I think Major Cole showed one case, and another was shown in the lantern demonstration in which the cardio-hepatic angle was not obliterated, but remained an acute angle.

Dr. Isaac Gerber.—I have had at least two cases where the border of the left ventricle of the heart was seen as clearly as in the illustrations shown yesterday by Dr. Cole; and in one of them I think the subsequent course of the case demonstrated clearly that the shadow we saw was actually due to the heart, because the first plate was a seven-foot plate, which presumably showed the true size of the heart within the partially distended pericardial sac; and a subsequent (seven-foot) plate, taken two weeks later, after the absorption of the pericardial fluid, showed the contour and size of the heart almost identical with the plate and shadow on the first plate. I felt that was proof positive that I really did see the shadow of the heart within the pericardial sac.

Maj. Willis F. Manges.—There was one striking slide in Major Cole's demonstration yesterday, that in which the effusion seemed to be almost entirely on the right side. While it apparently revealed a thickened pericardium it did not show any kind of effusion on the left side. My own belief is that if there is a pericardial effusion, it would be a most unusual thing to have it on one side only. I am inclined to believe that there was really a posterior mediastinal empyema rather than a pericarditis; it is not difficult to get the pus and feel that you have taken it from the pericardium. We had an almost identical case here last winter and traced out conclusively that it was a mediastinal—a more or less localized mediastinal—empyema, and not a pericardial effusion at all.

Maj. William H. Stewart.—As to Dr. Gray's paper: The presence of abdominal pain and tenderness with pneumonia, especially in children, is a common observation, and has been recognized for many years, and much has been written on that subject. Dr. Franz Torek, of New York, read a paper recently on that very subject, and laid particular stress on the character of the abdominal tenderness. He stated that it is almost a superficial tenderness. It is not a deep tenderness in the right iliac fossa. I find this especially true, as a number of cases that have come under

my observation showed that sign—that the tenderness is quite superficial.

In reference to the pericardium, I must support Dr. Cole. I have been able, I feel confident, to demonstrate the outline of the heart within a distended pericardial sac, particularly in one or two cases of general anasarca, in which we had a general effusion, pleural, abdominal and pericardial. We were able roentgenographically to state that the pericardial sac was markedly thickened, and we could distinctly see the cardiac outline within the shadow.

MAJ. A. L. GRAY.—Answering Majors Le Wald and Stewart, both of whom took up the question of whether or not the child whose slides I showed yesterday had pneumonia when it was operated on for appendicitis, the mental processes that have obtained in the minds of these gentlemen obtained also in my own mind at the time, and I went very carefully into the history and the laboratory findings to determine just that point.

In the first place, the blood-count showed a total leucocyte count of 9,500 when the child was brought in. It had been sick for some time, perhaps ten days or two weeks. The day, or about the time, that I made the first examination of this child's chest, as seen in the slide which showed the maximum consolidation, the leucocyte count was very much higher, and there was a very decided polynuclear percentage increase. Another thing: If you will recall, the pneumonia in this case was on the left side, not on the right. I wondered, when I discovered that the child had pneumonia, whether we had a case of left-sided pneumonia referred to the appendix, knowing that so often right-sided pneumonia is mistaken for appendicitis, and, as Major Le Wald said, the case operated on when there was no appendix involvement at all. The pathologists' report in this case was: No pathology whatever found in the appendix.

I want to add a word in respect to Major Cole's idea of demonstrating the heart inside the pericardial effusion. I am very certain that I have done it on several occasions; and what is more, whether it is possible or not, Major Cole has done it. The slides that he exhibited yesterday showed the outline of the heart inside the pericardium with an interval of from a fraction to an inch between the wall of the heart and the pericardium. Whether it is possible or not, I am inclined to think it is when you see it done.

THE ROENTGEN RAYS IN THE DIAGNOSIS OF APPENDICITIS*

BY GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PA.

IN THE great majority of cases the roentgen rays are not necessary for the diagnosis of appendicitis. This is especially true of acute appendicitis. In chronic appendicitis, however, the symptoms are very often obscure and the clinical signs and other evidences of an inflamed appendix are indefinite or are complicated by lesions in other organs. In these obscure cases the roentgen rays will give the greatest assistance in making correct diagnosis.

Acute Appendicitis.—In acute appendicitis the roentgen rays are very rarely necessary to assist in the diagnosis, but at least two points of diagnostic value can be demonstrated in these cases. (1) In that group of patients in which are symptoms of acute appendicitis due to an early pneumonia developing in the lower lobe of the right lung, the roentgen rays will be useful in demonstrating the lesion in the lung, thereby aiding in differentiating pneumonia from appendicitis. (2) A valuable point in the diagnosis of acute appendicitis brought out by Case is obtained by filling the colon to demonstrate the relations of the area of acute tenderness, and thereby assist in differentiating appendicitis from other affections of the organs in the right lower quadrant of the abdomen.

Chronic Appendicitis.—The chronic appendix gives much roentgen evidence of value in diagnosis. In the great majority of instances the patients sent to me for study, and in whom I find chronic appendicitis, are referred because of obscure stomach symptoms, in which the diagnosis of gastric ulcer is suspected, but the evidence is insufficient for an operation. In other cases the gall-bladder or duodenum is under suspicion, but it is my opinion that in all this group of cases where the symptoms are variable and may refer to the stomach, the duodenum, the gall-bladder, the kidneys, the appendix or the bowel, that nothing short of a complete roentgen examination of the entire gastro-intestinal tract, including the gall-bladder and at times even the urinary tract, should be made in order to reach a definite diagnosis. I cannot insist too strongly upon this point.

Otherwise important evidence will be overlooked, for one may find more than one organ involved, or the affected organ may be overlooked entirely. If any of these organs are studied separately and nothing is found, the patient has not been benefited; his symptoms continue; no diagnosis is made, and generally he becomes disgusted with the physician and with the methods used in diagnosis, which is a detriment to everyone.

Technique.—In this general group of cases, therefore, it is my practice to order for the patient a purgative, such as a bottle of citrate of magnesia at nine o'clock on the night preceding the examination. The patient then reports at nine o'clock the following morning without any breakfast, at which time a thorough study of the gall-bladder region is made, using six or eight plates. The patient is then viewed fluoroscopically at which time any gross abnormalities in the chest are noticed; the abdomen is viewed in general, at which time occasionally a biliary calculus or a urinary calculus may be observed before giving the opaque meal. At times even a urinary calculus will give rise to these obscure gastro-intestinal symptoms. The patient is then given a barium meal, consisting of approximately two ounces of barium in a pint of buttermilk or one of the

* Read by title before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Fort Oglethorpe, Ga., Sept. 6-8, 1918, entitled "The Roentgen Rays in the Diagnosis of Chronic Appendicitis and other Conditions in the Appendicular Region."

prepared fermented milks. This makes an excellent vehicle, as was originally demonstrated by me in 1907.[1] A careful study is then made of the stomach and duodenum, and if anything abnormal is found, the patient is again seen in three, four or six hours, depending upon the conditions. If nothing abnormal is observed at the first visit by a careful fluoroscopic examination, the patient is seen again at the end of eight hours, after the opaque material has entered the cecum and ascending colon, and one can make some of the preliminary studies with reference to the terminal portion of the ileum, the cecum, and, occasionally, at this time the appendix will be visualized. In some cases this is the only occasion at which the appendix can be demonstrated. Generally at this eight-hour period the appendix is not filled. The patient is next seen 24 hours after the first visit. At this time, in practically all instances, the cecum and ascending colon are well filled and, in the great majority of instances, the appendix can be demonstrated. The patient is allowed to continue with regular meals, after the first barium meal, unless something is found in the stomach or duodenum. No purgative is allowed during the entire study. At the 24-hour examination, studies are made with reference to the cecal region and the entire colon. The patient is next seen at the end of 48 hours, when further observations are made with reference to the ileo-cecal region, and the filling effect throughout the colon. The patient is then given a barium enema. This outlines the colon and further demonstrates its relation to other organs as well as its relation to the appendix. It also enables one to recognize any constriction or filling defect, and the patient does not have the objectionable drying up of hard barium masses, which sometimes gives trouble in their expulsion from the rectum.

The diagnostic points obtained through roentgenology are:

(1) *Localized Tenderness.*—This is the most valuable sign obtained, and is elicited either by direct palpation under the screen by means of the gloved hand, or much better (which is my practice), by means of a wooden spoon-like instrument, called a "distinctor." This wooden spoon can be passed readily under the screen and is controlled by the hand above the screen over the protection of the lead glass. If this spoon is surrounded by a rim of metal, one can easily move it around over the different parts of the colon, and different parts of the abdomen, and by watching the ring can definitely localize the tenderness of appendicitis in the cecal region or over the appendix, wherever it may be located. When the appendix is visualized (that is, when the barium meal enters the appendix so that it can be distinctly seen), one can often localize the tenderness directly over the appendix. When the appendix is movable, not infrequently the localized tenderness moves with the appendix. I have been able in a number of cases to move the appendix as much as three or four inches, and in each instance the sharply localized tenderness moved with the appendix. This may seem contradictory or inconsistent with some of the ideas of the sensibility of the viscera, but whether contradictory or inconsistent, it is a fact. Without suggesting to the patient, I have been able to move my wooden spoon around over the abdomen, and in each instance when I came back to the location of the appendix, the patient complained of pain even though I had moved the appendix from its original place. This tenderness is persistent and is present throughout the various studies made. At times this tenderness is acute and sharply localized, and at others is a more or less general and less acute tenderness. A vague tenderness is more likely when the appendix is retrocecal when there is considerable soreness; but the tenderness is not sharply localized until one twists the patient in such a manner as to bring the pressure directly to bear upon the appendix, in which instance it is often quite acute. If no tenderness is present and if at the same time the cecum is freely moveable, I believe that one can say that no

appendicitis exists. On the other hand, if there is localized tenderness over the cecum with fixation of the cecum and no visualization of the appendix, it very frequently means an obliteration of the appendix by inflammatory exudate which prevents the appendix from filling with the barium meal. Localized tenderness, with fixation of the cecum, and without filling defect, is, I believe, strong evidence of appendicitis. Clinically the surgeon and physician are apt to look for tenderness over McBurney's point. As we have many opportunities of studying the position of the appendix and the localized tenderness, we realize how much in error we may be if we depend upon localized tenderness over McBurney's point as evidence of chronic appendicitis. For example, if the appendix is located deep in the pelvis there will be absolutely no tenderness over McBurney's point. Likewise, if the appendix is located in the hepatic region, and very commonly when the appendix is retrocecal, there is no localized tenderness over McBurney's point. Then too the appendix may be on the left side instead of the right, either due to non-rotation of the colon or to complete transposition of the viscera.

(2) *Demonstration of the Appendix.*—The appendix can occasionally be demonstrated by the opaque enema, but in many more instances it is demonstrated by means of the opaque meal, particularly when the latter is administered with buttermilk. Case reported a demonstrable appendix in 273 out of 763 cases which were referred because of gastro-intestinal symptoms. George and Gerber have succeeded in demonstrating the appendix, either normal or pathological, in 7 out of every 10 cases. Quimby in 141 cases was able to obtain sufficient data to determine the condition and the position of the appendix in 90 per cent of them. The remaining 10 per cent were those in which the position of the cecum prohibited a thorough inspection. I believe that, in the majority of cases referred for gastro-intestinal study in which the barium and buttermilk meal is administered, the appendix can be demonstrated if one looks for it at the end of 8 hours, at the end of 24 hours and at the end of 48 hours. It is not always visualized in a plate made of this region but if one palpates the cecum by means of the wooden spoon or distinctor, and if the appendix has been filled with the barium, it can, I believe, always be demonstrated even if it is lying behind the cecum. To accomplish this, one should rotate the patient to the right or to the left sufficiently to bring the posterior surface of the cecum into view; the appendix can then be demonstrated if it is filled with opaque material. I believe that no case is thoroughly studied unless this procedure is followed. Regarding the significance of bismuth fillings of the appendix, Skinner, after reviewing the literature on the subject, states that there is no agreement. At one extreme we find Groedel stating that the ability to demonstrate the opaque filled appendix is a sufficient basis for accusing it of being pathological. Case is inclined to the view that the appendix which can be filled with bismuth, if not definitely pathological, is at least potentially dangerous. George and Gerber agree with Case in those cases where bismuth remains in the appendix 48 hours or more after it has passed out of the contiguous intestinal tract, while Imboden states that the mere presence of some of the opaque material still in the appendix is no indication of chronic disease. Cohen says that fecal contents enter normally into the appendix.

(3) *Fixation.*—A chronically inflamed appendix is very likely to become more or less attached to the surrounding tissues. It may be attached only at its tip, in which case the greater portion of the appendix could be moved around freely, together with the cecum, and yet the tip of the appendix remains in a stationary position. On the other hand, the appendix may be fixed throughout, or it may be fixed at its base, and the tip of the appendix may be movable. However, absence of fixation or evidence of adhesions about the appendix

must not be regarded as negative evidence in the diagnosis of chronic appendicitis, for we all know that an appendix may be inflamed and yet be freely movable. In this instance, the localized tenderness again is of most value.

(4) *Position of the Appendix.*—Normally the appendix is directed downward into the pelvis, but normally it is freely movable, and changes its position without external influence to a considerable extent during 24 or 48 hours. It not only changes its position but its shape, indicating that there is likely some vermicular or peristaltic movement associated with the appendix. One may find, therefore, a chronic appendix in a normal position lying in the pelvis, lying transverse or lying along the inner side of the ascending colon; it may be retrocecal or, as in one case of mine, the appendix was wound around the pyloric end of the stomach. In a number of cases I have found it up in the gall-bladder region, in which instances the patients are generally sent for a gall-bladder examination rather than an appendiceal study. In general, when the appendix is directed upwards or is retrocecal, it is more likely to indicate chronic appendicitis.

(5) *Kinking or Angulation of the Appendix.*—The mere bending of the appendix has no significance, for the shape of the appendix will vary many times within 24 hours, but if there is a fixed angulation it is very commonly due to an adhesion at the point of fixation. This has distinct significance.

(6) *Constriction.*—Constriction, dilatation, or irregularities in the lumen—these may consist of a bulbous portion, the whole appendix may be much dilated or one may have marked irregularity in the lumen. All of these, I believe, have pathological significance.

(7) *Abnormal Retention.*—If the appendix remains filled with barium after the cecum and ascending colon have become empty or after the entire colon is emptied, I believe that it has pathological significance. On this point I am in accord with opinions expressed by Case, George and Gerber, and Imboden.

(8) *Incompetent Ileocecal Valve.*—The incompetency of the ileo-cecal valve can often be recognized by the fact that at the end of 24 hours after giving an opaque meal, the ileum is usually entirely empty, and yet at the end of 36 or 48 hours the terminal portion of the ileum may contain some of the opaque material. This surely means, and is the best demonstrable proof of, incompetency of the ileocecal valve. It is due to regurgitation of the contents of the colon into the ileum, and is probably carried there by reversed peristalsis.

OTHER ROENTGENOLOGICAL EVIDENCE OF PATHOLOGY IN THE RIGHT LOWER QUADRANT OF THE ABDOMEN.

(1) *Enteroliths in the Cecum*, such as were demonstrated in the cases reported by Stamm and the writer.[2] In one of these cases the enterolith consisted of a fecal mass, globular-shaped, about an inch and a half in diameter, movable between the cecum and several inches higher in the ascending colon. It gave rise to pain in the right iliac fossa, and also was associated with recurring attacks of diarrhea. It was finally carried to the rectum, after many glycerine enemas, and was removed digitally from the rectum by the attending physician at the end of two months.

(2) *Adhesions of the Cecum to the Side of the Rectum.*—This condition is illustrated by the case of a young man who for 20 years suffered with constipation, but at the same time had constant desire for stool. Yet, no matter how often he emptied his bowels, he still had the desire for further rectal expulsion. This symptom was found to be due to a dilated cecum attached to the rectum. The cecum, becoming distended with fecal matter, pressed upon the rectum, gave the patient a desire for stool and the patient was continually making the effort to expel the cecum through the rectum; without success, of course. This patient was relieved by operation.

(3) *Carcinoma of the Cecum.*—Carcinoma of the cecum is associated with two of the most important roentgenological symptoms of chronic appendicitis, namely, localized tenderness and fixation. But one can differentiate these because of the filling defect in the cecum due to the carcinoma. This filling defect is practically always absent in connection with chronic appendicitis, excepting when a large appendiceal abscess is present, which produces a pressure defect. The pressure defect can be differentiated by the smooth rather than the serrated outline.

(4) *Psoas Abscess or Iliac Abscess,* which ultimately points to the neighborhood of Poupart's ligament, may give rise to localized tenderness, with a great deal of pain and distress, and the consideration of chronic appendicitis is often forced upon us. In these cases an examination of the spinal column will help to clear the diagnosis, and generally the cecum and appendix are found to be freely movable unless there is associated chronic appendicitis. The two conditions may, of course, be present at the same time.

(6) *Urinary Calculus.*—I have seen several cases operated upon for chronic appendicitis, when a subsequent roentgen examination demonstrated the presence of a ureteral calculus. Even renal calculus may give reflected pains in the right quadrant of the abdomen.

CONCLUSIONS

1. Chronic appendicitis commonly gives obscure symptoms.

2. A complete and careful roentgenological study will give valuable evidence in all cases.

3. A definite diagnosis, either positive or negative, can be made in the majority of cases.

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THE ROENTGENOLOGICAL FINDINGS IN A CASE OF PYOPNEUMOTHORAX SUBPHRENICUS DEXTER

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THOUGH there is an extensive literature on subphrenic abscess containing gas and it is a fairly well known condition, still it seems worth while, for reasons that will appear, to report the roentgenological findings in such a case. A search of the available roentgen-ray literature reveals but one example, that of Col. James T. Case in his "Stereoroentgenography of the Alimentary Tract." This, resulting from a perforated gastric ulcer, does not give particularly striking findings. Nyary has a description of a case in the *Deutsche med. Wchnschr.* (1915, No. 38), but his report is unaccompanied by illustrations. Medical writers generally content themselves with the statement that the roentgen-ray examination is helpful, or will clear the diagnosis, but are not precise in stating how this desirable end is achieved. As a matter of fact, the condition presents a characteristic and beautiful roentgen-ray entity, as will be seen in the case to follow.

Formerly of fairly frequent occurrence, pyopneumothorax subphrenicus is becoming less common as gastric conditions and appendicitis (the two chief sources whence it arises) receive their proper surgical treatment. It can hardly occur, save in a surgically neglected patient such as the subject of this report. He, prior to his coming to this clinic, had been treated for "worms."

An abstract of the history of this case, with the roentgen findings, follows:

Frank Y., aged five years, came to the Orthopedic Clinic of the Washington University Dispensary June 26, 1918, complaining of his back. Examination revealing that he was not an orthopedic case, he was immediately referred to the Department of Pediatrics. A history of an attack of vomiting four weeks previously, followed by pain in the abdomen, right side and back, with fever, was obtained. Fever and pain continued, accompanied by wasting and an increasingly bad condition. Physical examination being unsatisfactory and inconclusive, he was referred to the roentgen-ray department for a roentgenogram of the chest, and ordered to report the following day. This plate (Fig. 1, made in the prone position) showed heart apparently displaced to the left, slight scoliosis (convexity to left), lung fields clear, diaphragm disproportionately high on right side. Below the latter there was a clear, gas-filled triangular space, with the greatest side somewhat concave, directed downward and inward, the lowest point level with the tip of the eleventh rib. From this lowest point there extended a narrow gas-filled space towards the iliac fossa.

FIG. 1. PRONE POSITION.

The child, admitted to the Children's Hospital the next day, gave briefly the following findings on physical examination: Patient very ill; respiratory movement largely confined to the left side of the chest; liver dullness in the sixth interspace and midclavicular line. On the right side there was a space bounded above by a horizontal plane passing through the tenth thoracic vertebra, anteriorly by the anterior axillary line, posteriorly by the spine, and extending downward to an apex in the midaxilla at a point midway between the iliac crest and the costal margin, over which there was tympany to percussion; abdomen distended; liver edge palpated two cm. below costal margin throughout its extent. A definite, irregular mass was found in right lower quadrant, beginning in the pelvis and extending up the right flank, seemingly continuous with the liver. A marked leukocytolysis existed.

FIG. 2. ERECT POSITION.

Fluoroscopic Examination: Erect posture, right leaf of diaphragm immobile, excursion of left leaf increased. Below the diaphragm on right side was a reniform, clear, gas-filled space, the lower pole of which was cut off by a definite, horizontal, straight line. This line remained horizontal on bending the child laterally, and wave motion was elicited by shaking the patient. Postero-anterior view corroborated these findings. Supine posture showed the same conditions as the erect, save that there was less clarity over the area noted above. The shape of the clear area changed from reniform to triangular. From the lowest point of this triangle, a narrow, gas-filled space ran down and internally toward the pelvis. Roentgenograms were made in these two positions. (Figs. 2 and 3.)

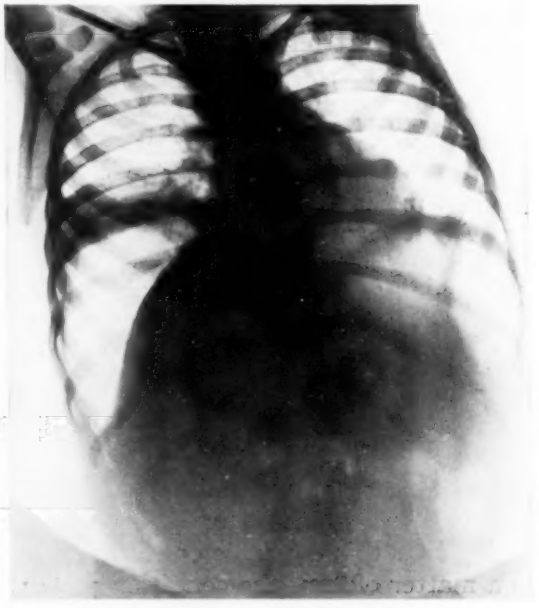

FIG. 3. PRONE POSITION.

These findings warranted the roentgenological diagnosis of a gas-containing subphrenic abscess, probably originating from the appendix. Aspiration was performed, and a small amount of pus withdrawn for examination. It contained many streptococci and colon bacilli, and presented the general characteristics of pus from a chronic, walled-off abscess.

All methods of examination concurring in a diagnosis of abscess, immediate operation was decided on. Incision and drainage

were made by Dr. A. O. Fisher. A large amount of foul pus, gas and an enterolith were evacuated. A large cavity was found extending upward from the right iliac fossa, investigation of which was precluded by the patient's condition. Patient stood operation well, but his experience immediately following it was stormy.

Roentgenological examination made August 7, forty days after operation, gave approximately the same findings as those of June 28, save that there was no collection of fluid present. Fig. 4 (made in the supine position) shows condition on that date.

The child has gradually improved and is now quite well, save for a slight fecal fistula. Fluoroscopic examination on this date,

FIG. 4. SUPINE POSITION.

December 7, shows equal and full diaphragmatic excursion on the two sides and absence of the gas-filled space previously observed. Fig. 5 (taken in the prone position) shows the present condition.

A recapitulation of the salient features of the roentgen-ray findings in this case seems not out of place:

The presence of a collection of gas beneath the right leaf of the diaphragm,

FIG. 5. PRONE POSITION.

the outline of which is modified by change of posture. Its definite outlining of the peritoneal reflection composing the right lateral ligament of the liver, thereby assuring that it, the gas, lies intraperitoneally.

The collection being *external* to the right lateral ligament of the liver, eliminates the stomach and duodenum as the source of the affection. This same fact, taken in conjunction with the situation of the collection just beneath the lateral abdominal wall, practically assures the cecum, appendix or ascending colon as the primary seat of disturbance.

The existence of a fluid level below the gas when patient is erect, and the demonstration of its shifting on movement.

The existence of a narrow, gas-filled canal leading towards the pelvis, which implicates the appendix as the origin of the condition.

The relatively large amount of gas and small amount of fluid in the space, from

which the natural inference is that an opening into the intestine existed, allowing ingress of gas and egress of fluid, which was confirmed later by the development of a fecal fistula.

The absence of infiltration of the bounding tissues with gas, in contradistinction to the action likely to be found in gas bacillus infection and traumatic emphysema.

The slow collapse of the cavity after drainage.

The existence of an undamaged lung and diaphragm above.

In conclusion, I wish to express to Drs. P. C. Jeans and A. O. Fisher my appreciation of the privilege of reporting these findings, as the case belonged to their respective services.

COMPLICATIONS IN PNEUMONIA

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PLEURITIC effusions are most frequently found in the lower quadrants and are usually retained there by pleuritic adhesions. However fluid may be fixed or encapsulated in any position or location in either pleural cavity. Also it may be free in the pleural cavity and change its position and shape as the patient's position is changed. The patient should be in an upright position, as a small amount of fluid free in the pleural cavity may form a thin layer and be difficult of detection with the patient in the dorsal position. Protective adhesions are formed between the visceral and parietal pleura, at the junction of the inflamed and normal pleura, thus encapsulating the fluid. Encapsulations in the upper quadrant often follow drainage of a large collection in the lower quadrants.

Fluid in the lower quadrants may be located immediately over the diaphragm, occupying the entire costo-phrenic sinus, the lung being compressed entirely from below upward. It may be located anteriorly, posteriorly or laterally, or may occupy the entire sinus and compress the lung from the three sides rather than from below. The differential diagnosis is sometimes rather difficult from both plates and fluoroscopy, especially if the fluid is under pressure and very thick. The decrease in radiability is so marked that the diaphragm cannot be made out or the depth observed stereoscopically if the lung is so compressed that very little or no air enters it. On account of pleuritic adhesions following rib resection in the encapsulated cases there is usually very little lung collapse. If there are no pleuritic adhesions, marked lung collapse is not obtained on account of the lung consolidation. Pleuritic adhesions are formed before resolution begins, especially if negative pressure is applied at the beginning of resolution and

FIG. 1.

Encapsulated empyema, upper right quadrant.

* Authority to publish granted by Board of Publication, Surgeon General's Office, Washington, D. C.

before the visceral pleura is thickened and contracted.

In extensive pleuritic effusion under pressure with marked heart displacement

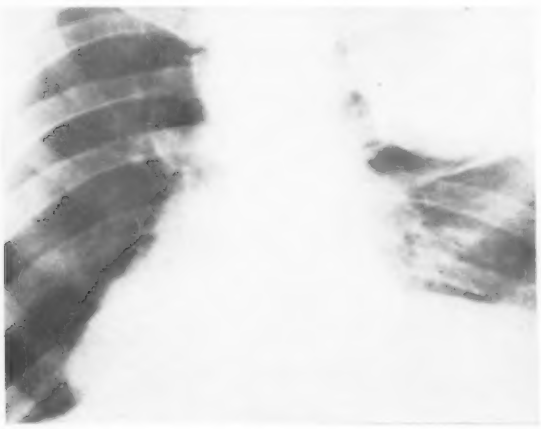

FIG. 2.
Encapsulated empyema, upper right quadrant. Note the interlobular adhesion.

and considerable lung collapse the heart silhouette will apparently be enormously increased in area and will suggest pericardial effusion. Confusion in this case is more likely to occur if the right pleural cavity is involved. Pericardial effusions produce a marked abnormality in configuration of the heart silhouette. The vesiculo-auricular angle on the right side is decreased in obtuseness, the result of the vesicular bulge and the right cardiac border is exaggerated. There is also an absence of the left auricular shadow and the pulmonary root shadow. The cardio-phrenic angle usually remains acute, especially on the right side. The left may become obtuse. We have had one case with purulent pericardial effusion which undoubtedly ruptured into either the trachea or a large bronchus. A quantity of offensive purulent material was coughed up. A roentgen-ray examination then showed a normal heart silhouette with indications of a thickened pericardium along the right border. (See Figs. 12 and 13.) The patient

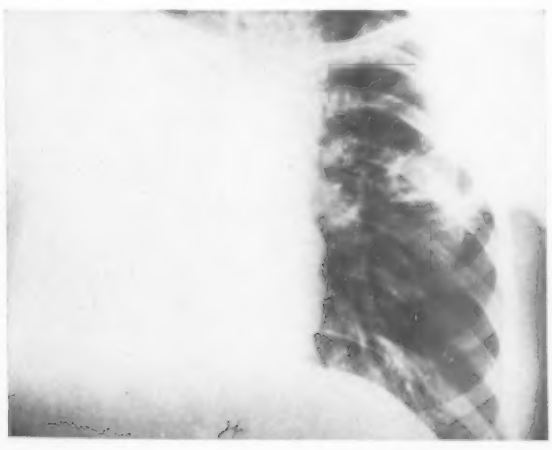

FIG. 4.
Extensive pleural effusion. No heart displacement. Interlobular adhesion right side.

FIG. 5.
Extensive pleural effusion (right).

died following a disseminated inspiration pneumonia, but the autopsy failed to reveal a communication between the pericardium and the bronchus. However, the pleuro-pericardial adhesions were very dense.

Encapsulated interlobular collections of fluid are very difficult to recognize. They are most often found between the right upper and middle lobes. This is probably because of the slight convex upper surface of the middle lobe and the tendency for adhesions to form between inflamed interlobular visceral pleura where it overlaps

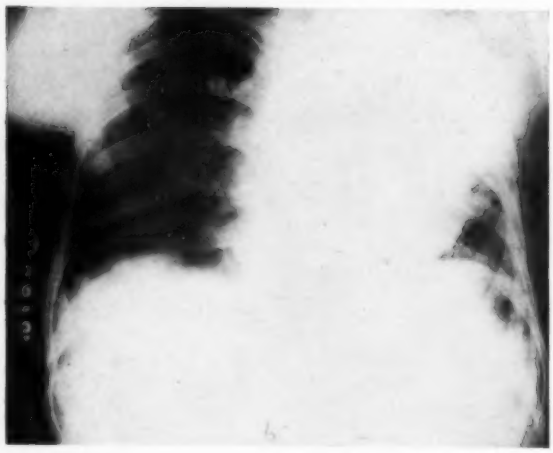

FIG. 6.
Encapsulated pleural effusion, upper left quadrant.

FIG. 7.
Encapsulated pleural effusion, upper left quadrant.

FIG. 8.
Encapsulated effusion, upper right quadrant.

FIG. 9.
Left pleural effusion. (Note heart displacement.)

FIG. 10.
Pleural effusion, lower right.

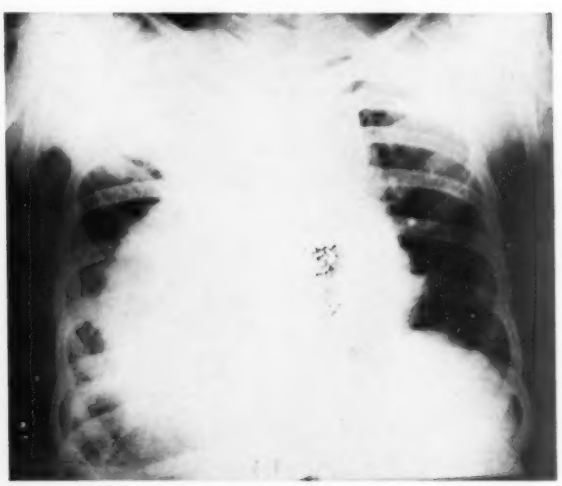

FIG. 11.
Pericardial effusion complicating confluent bronchopneumonia, upper left.

the visceral pleura covering the lobe. This causes retention of fluid between the lobes. These are noticed on a flat plate as fan-shaped uniformly dense areas with the apex at the hilus and the base at the lateral chest wall behind the fourth and fifth interspace in front. Stereoscopy determines the cone shape, most of which is thickened interlobular pleura, the fluid being usually small in quantity. This fluid is absorbed eventually or organized into fibrous tissue, but may increase sufficiently in quantity to rupture into the pleural cavity, producing a general pleuritic effusion.

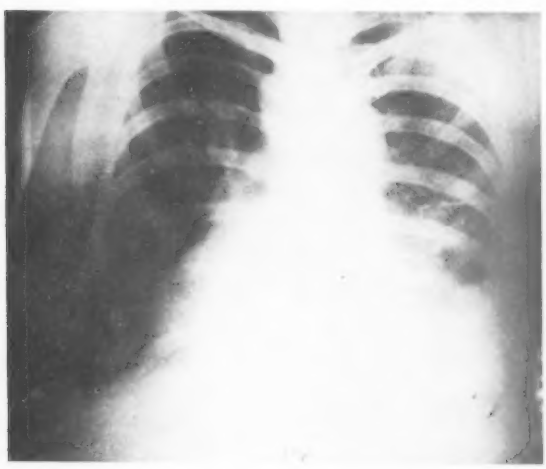

FIG. 12.
Pleural effusion, lower right. Pericardial effusion.

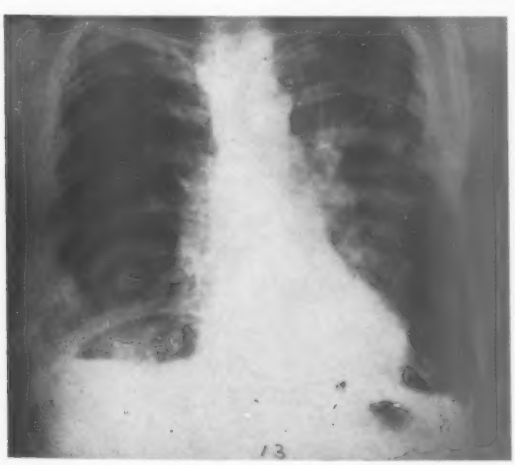

FIG. 13.
Same case as Fig. 12 following spontaneous rupture.

FIG. 14.
Emphysematous excavation. Exposure made after lung was removed.

We have noticed several cases of emphysema along the course of the pulmonary vessels. This is most marked along the surface vessels and apparently begins at the periphery and extends toward the hilus by dissection. Two of these cases eventually ruptured the visceral pleura and produced a spontaneous pneumothorax.

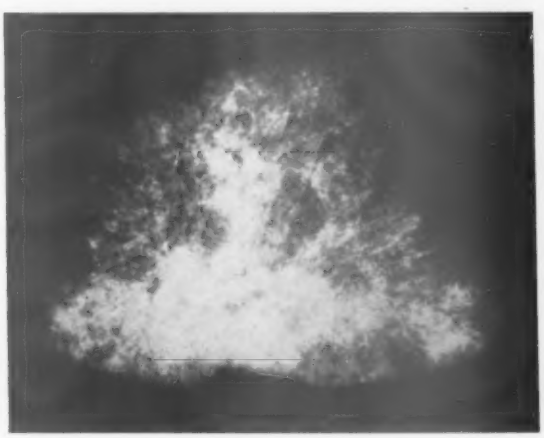

FIG. 15.
Pulmonary emphysema. Exposure made after lung was removed.

One of these cases developed into pyopneumothorax, the fluid being free in the pleural cavity. In pneumothorax the air is under pressure displacing the heart and diaphragm. The degree of pressure depends upon the degree of obstruction to the passage of the air out of the bronchiole back

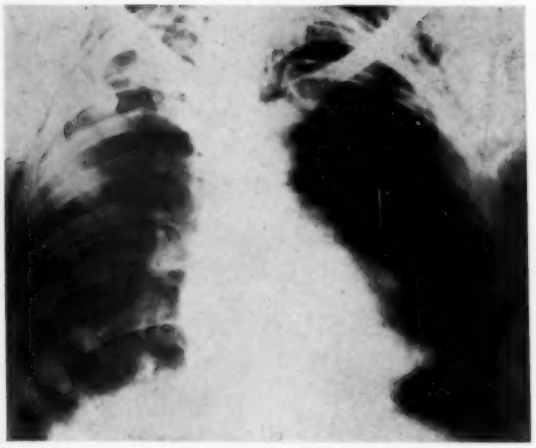

FIG. 16.
General emphysema. No pneumothorax. Note air in axillæ.

to the bronchus. The emphysema along the vessel presents an elongated area of increased radiability extending from the periphery almost to the hilus. It is differentiated from a dilated bronchus because the borders are scalloped rather than uniform and because there are no indications of fibrous tissue infiltration as in bronchiectasis. We

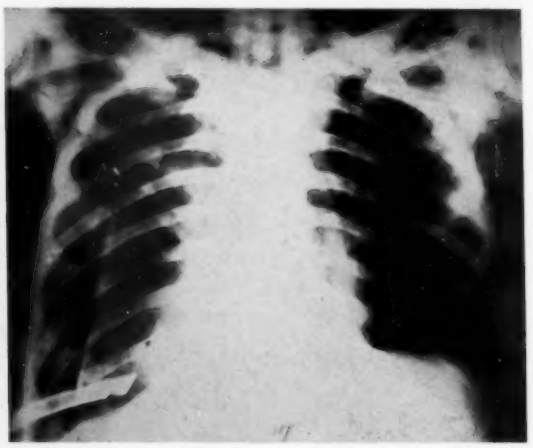

FIG. 17.
Chest plate in general Emphysema, following rib resection. Note air in axillæ.

have detected several cases of emphysematous excavation. These are shown on the plate as large clear oval shaped areas, usually several in the same quadrant and not diffusely distributed. These areas are evidently not a true emphysema but excavations due to rupture of dilated air sacs. Hence the name "emphysematous excavation." Fig. 15 demonstrates a true general pulmonary emphysema, while Fig. 14 shows the excavation. From a roentgenological study of these cases and observation at autopsies we have determined that the mechanics of generalized emphy-

FIG. 18.
Pyopneumothorax, right. Note extensive pleuritic bands.

sema is probably as follows: There is a marked peribronchiolitis, the congestion producing an impingement on the lumen of the bronchiole causing a bronchiolectasis. Continued violent coughing increases the distention and a rupture of either a

FIG. 19.
Pneumothorax, left.

bronchiole sacculation or of a distended air sac results. Adhesions are formed between the soft areolar tissue of the anterior mediastinum and the thin inner border of the lung, when the pressure of air in either the distended air sacs or the emphysematous excavation becomes almost sufficient to rupture. If the pressure continues on account of increased impingement on the lumen of the bronchiole, the emphysematous excavation ruptures. Air is then admitted into the tissues of the anterior mediastinum and is distributed over the body until the pressure in the soft tissues balances the pressure distal to the constricted lumen of the bronchiole through which the air must travel to reach the anterior mediastinum. The process is mechanically the same as that which produces the dilatation of the secondary bronchus in bronchiolectasis. Pneumothorax results if adhesions are not formed between the lung border and the mediastinal tissue, or if the process takes place at another location on the lung surface.

In old, chronic pleuritic effusions the pleura is so thickened that the rib outline cannot be made out except at the lateral chest wall where the fluid is thin. These cases seldom show marked heart displacement, because the pleural fibrosis eventually contracts and pulls the heart back, the pressure on the fluid causing absorption and finally organization until only a small quantity remains encapsulated in a dense thickened pleura. Old encapsulation in the upper two-thirds of the lung field is more often posteriorly situated in the fossa near the spine and is usually distinctly circumscribed and small in area; the largest I have seen was the size of a small orange.

FIG. 20.
Lung abscess.

FIG. 21.
Lung abscess.

We have examined seven cases of broncho-pneumonia, complicating tuberculosis. In the advanced fibro-caseous type the differentiation is made comparatively without difficulty, particularly if both processes are observed on the same plate. Lung abscesses are comparatively rare and must be differentiated from encapsulated pleuritic effusion. In case of lung abscesses, if the patient is examined in the upright position, a fluid level is observed which maintains a level parallel with the floor when the patient flexes his body. There is seen usually a collection of air above this level. The same may be seen in pleuritic effusion, but such cases are not so likely to occur. Stereoscopic plates will demonstrate the central location of the fluid, as will the screen when the patient is viewed in the oblique position.

ROENTGEN-RAY PROBLEMS IN AN OVERSEAS NAVY BASE HOSPITAL

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THE difficulties encountered in establishing the roentgen laboratory in U. S. Navy Base Hospital No. 4, located at U. S. Navy Base No. 6, Queenstown, Ireland, were of so instructive a nature that it seems worth while to place them on record for the benefit of those roentgenologists who may be required to establish such a laboratory at any future time.

This Base Hospital Unit was organized at the Rhode Island Hospital, Providence, R. I., in April, 1917, a few weeks after the declaration of war. At the request of the government, this unit was assigned to the Navy and was organized as a 250 bed hospital. The writer was asked to assume the duties of roentgenologist and orthopedic surgeon. The medical staff was limited to ten officers at the beginning but later was increased to 18 officers on the basis of a 500 bed hospital.

It was recognized early that the conditions under which roentgen-ray work would be performed in this war were vastly different from those of civil practice. The laboratory might be located under a tent near the firing line or it might be in an elaborately equipped base hospital, as well adapted for all kinds of roentgen-ray work as any civil hospital. All conditions must be provided for, since the operator very probably would be his own mechanic and electrician in case of trouble. Knowledge of machine construction, wiring and the ability to locate trouble are necessary qualifications of the roentgenologist working under war conditions.

The writer obtained the courteous permission of the Surgeon General, U. S. A., and the consent of the Surgeon General, U. S. N., and in July, 1917, attended the School of Military Roentgenology which had been established recently at the Cornell Medical College, New York.

Particular attention was paid in this course to machine wiring, repair of trouble without recourse to a professional electrician and the use of simple apparatus. The standard U. S. Army portable roentgen-ray outfit had just been put on a sound footing and already was being used in Army Base Hospitals overseas. At the School much emphasis was laid on the necessity of taking along one's own power plant, since the voltages in Europe were known to vary greatly. There was also the possibility of being assigned to some locality where electric current would not be available.

When the roentgen-ray equipment for this hospital was purchased in the fall of 1917, the writer presented these arguments to the U. S. N. medical officer who was charged by the American Red Cross with the purchase of all equipment for Base Hospitals. It was urgently insisted that only a portable roentgen-ray outfit should be purchased. With such apparatus one could always be sure of an adequate power plant. This portable outfit was adapted to all kinds of work except rapid gastro-intestinal roentgenography. The expense of establishing the roentgen-ray equipment at this base hospital has been conservatively estimated at about $5,000, whereas the portable outfit could have been obtained with necessary accessories for about one-fourth of that sum.

These objections were overruled and a 7½ K.W. transformer of standard type, operating on 220 volts A.C., was purchased. A complete equipment of accessories, including a table adapted for horizontal fluoroscopy, a stereographic tube stand, a

vertical fluoroscope, vertical plate changer, stereoscopic view box, eye localizer and dark room outfit was obtained. Some of this apparatus was unnecessary in a hospital of this character and was never unpacked. To allow for the possible necessity of adapting the existing voltage to the needs of this transformer, a rotary converter of 7½ K.W. capacity at 110 volts and an autotransformer capable of delivering up to 240 volts, 60 cycles A.C., were included in the equipment.

The Commanding Officer of the hospital was informed of the voltage requirements of the transformer and determined to secure a central heating and lighting plant for the use of the hospital and adjacent barracks as well. If this had not been accomplished no power could have been provided for the roentgen-ray plant. The nearest municipal supply line is a mile distant from the hospital and the voltage supplied is 220 D.C. An extension of this line could not be obtained since the capacity of the plant is only 50 K.W.

By good fortune, two 15 K.W. D.C. generators of 220 volts capacity each were purchased in England. These generators were belt-driven from two single-cylinder, high-speed, vertical type engines. These generators and engines were purchased largely with the view of furnishing power for the roentgen-ray laboratory. Otherwise, the entire heating and lighting plant would have been planned on a simpler and more economical basis. A 12 H.P. 220 volt D.C. motor was purchased—incidentally at a cost nearly approximating that of the Army portable roentgen-ray outfit exclusive of accessories—and belted to the rotary converter. The field of the converter was thus excited from the D.C. supply and 70 volts A.C. were delivered on the slip rings of the converter. By passing this current through the autotransformer about 240 volts A.C. were obtained. It was necessary to mount the transformer and the motor and rotary converter on separate concrete piers to prevent vibration. The rotary converter was wound for 110 volts and it was not practicable, with the facilities at hand, to rewind it for 220 volts. The small capacity of the converter was appreciated but it was considered probable that it would carry a sufficient current to operate the transformer to capacity.

On attempting to pass this converted current through the roentgen-ray transformer, it was found that the line voltage dropped to 180 volts or lower and that only 12 to 14 amperes could be obtained in the primary of the transformer circuit. The connections in the small synchronous motor transformer were changed so that it would operate on 200 volts, 50 cycles, and on 175 volts, 40 cycles, but no differences were observed in operating conditions. The maximum milliampereage which could be passed through the Coolidge tube circuit was 35 ma. with a back-up spark gap of three inches. Any attempt to raise the voltage at the tube terminals resulted in a lowering of the milliampereage.

Consequently an entirely different technique had to be developed. It was necessary to make exposures practically simulating those made with a portable outfit. By increasing the exposure time it was possible to obtain very good negatives of small parts and lungs. Antero-posterior views of the head and other deep parts were obtained only by the use of an intensifying screen and a very long exposure. Rapid gastrointestinal work was impossible with the equipment.

Electrical engineers and practical electricians from the repair ships stationed at this base were consulted and offered valuable suggestions and timely aid. Indeed, without their help it would have been impossible to operate the transformer. Their facilities and knowledge enabled them to make repairs and even design certain parts of the equipment which would not have been feasible in any other way. I wish to take this opportunity to express thanks to Lieutenant (junior grade) Harry Segel, U. S. N. R. F., for his advice and assistance. He designed a switchboard,

provided some accessory apparatus, worked out the wiring problems and instituted many repairs. As delivered, one of the connections in the motor circuit of the transformer was incorrectly made; one of the resistance units in this circuit was broken and the other burned out. The polarity indicator failed to work and the meters had to be overhauled.

The difficulties under which we labored could be overcome in all probability by rewinding the rotary converter for 220 volts; or another converter of 110 volts could be obtained and run in series with the first one. We should have adopted one of these expedients if the war had continued.

The experience with this roentgen-ray equipment demonstrates the importance of providing portable outfits with their own power plants for use in base hospitals which, for all practical purposes, are to be regarded as field hospitals. With such apparatus, patients unable to be moved to the laboratory can be examined in bed. If it seems advisable to provide a transformer and other equipment, such as are used in permanent hospitals, an adequate power plant should be provided with it.

COOPERATION OF ROENTGENOLOGISTS AND OTHER MEDICAL OFFICERS*†

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IN EVERY department of medicine, cooperation with the roentgenologist and other physicians has but one meaning and that is "team work." It has been the experience of most physicians in their private practice or hospital work, that to obtain a sufficient amount of clinical data from the one who has studied the case is sometimes a difficult problem. Only in recent years have hospitals attempted to improve their clinical records and bring them up to a standard for future reference. There is, however, at the present time, a general trend toward hospital betterment and the establishment of a wider cooperation between their various departments. In other words, the establishment of medical conferences stimulates discussions and case study, for the betterment of all concerned.

In the past it might have been said that some hospitals were conducted largely for the benefit of physicians, with lack of consideration for the patients. While this may have been true in a limited sense, the model hospital of today is attempting to establish the widest cooperation of physicians, executives and patients, with the patient the primary object. With this in mind there can be but one solution and that is team work of the departments.

Civilian hospitals should be managed by competent, well-trained business men of wide experience, with the object of making the hospital a home for the sick and injured and assuming all financial responsibility of running the institution; knowing the needs of each department and making each department responsible and efficient. In a hospital thus conducted there is presented to the roentgenologist means of confirming his work by better cooperation with his consultants.

Roentgenology requires no comment as to its art. History will record the wonderful achievements in the recent great war made possible by the roentgen rays.

The roentgenologist is no longer the picture-making artist. He is a student of medicine in its widest sense. The further

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† Permission to publish granted by the Board of Publication, Surgeon General's Office, Washington, D. C.

he advances in his art, the more of a clinician he becomes. He must know all branches of medicine thoroughly and continue to be a student. He must be a good clinician, a good pathologist and, moreover, a good anatomist. If he has not a special knowledge of the diseases of the bones and joints and the new growths, his work will be exceedingly difficult. A special knowledge of both the gross and microscopical pathology is of the utmost importance in rendering an interpretation. It is of great advantage to keep in touch with the clinical history that a thorough understanding of the case may be had.

It has been the contention of some roentgenologists that the case history either before or after the roentgen-ray examination is not desirable but that the diagnosis should be made entirely from the roentgen-ray findings. Others have desired the history only after an interpretation has been made, to aid in the final conclusion. However, recently, many roentgenologists have desired all of the clinical data available at the first examination so that any additional study may be made at the time, rather than have the patient return for future study.

In private practice it is often difficult to obtain the notes of the patient from the physician, except as he comes to consult concerning the roentgen examination. In hospital practice there should be no difficulty in obtaining the history. The consultant should have all the available data at the time of his examination and this can only be accomplished by thorough harmony and team work.

Errors have been made in the examination of the gastro-intestinal tract by mistaking the pressure of extra gastric tumors on the stomach wall for malignancy of the stomach, the nature of the tumor not being recognized by either the roentgenologist or the clinician, through carelessness in history taking, the absence of a blood examination (as in the case of a splenic tumor) or the forgotten urinalysis (as in a pancreatic tumor). Thus many instances are due to faulty team work.

The experience of the writer as a medical officer doing roentgen-ray work in a U. S. General Hospital has demonstrated that cooperation with the medical officers of the various departments is most essential. The roentgenologist who shows keen interest, willingness to consult, to demonstrate and to advise will be able to obtain clinical histories on request.

There is, however, an opportunity for improvement in this team work. This can be accomplished by holding weekly, or even daily, designated hours for consultation and interpretation of plates in the roentgen-ray laboratory; a means whereby each other's viewpoints of the case may be obtained. The roentgenologist who limits his field to only the plates before him for his conclusions in all cases is losing much valuable information and not gaining ground.

The request sheet for roentgen-ray examination in the medical department of the army, though somewhat small, conforms to the other history and hospital forms and for all practical purposes is sufficiently large to contain all the clinical history which the roentgenologist requires.

However, one obtains requests made out in the following manner: "Request: Examination of Mastoids." There is no history. Whether the condition is acute or chronic is not stated. Neither is the infected side specified, but as plates are made of both mastoids for comparison that may not be considered essential. But this is not satisfactory to the roentgenologist. The patient may have both ears plugged with cotton and the head bandaged. It should be the duty of the otologist to give you the information that this case has had measles with an infection of the middle ear. There are symptoms of right mastoiditis. The left mastoid was operated on ten weeks previously and has not healed. All this data is important when the plates are studied. We find it often difficult to differentiate between sclerosis from an old infec-

tion with extensive cell destruction and a very recent cell destruction. Then also we may wish to differentiate between a mastoid normally showing no well defined cell area or no pneumatic cells and a very old sclerosis.

Clinical data on any sinus infection helps greatly in clearing up doubtful cases of a chronic type.

As for the teeth, the dentist is more specific, depending on the tooth involved. It is necessary, however, for him to specify a certain tooth by the method as adopted in the "Army *X*-ray Manual." A request for teeth examination usually means all the teeth and should read so. If in search of some focal infection he should state arthritis of the knee, hand or ankle (as the case may be); "look for possible source of infection in the teeth."

Roentgen-ray examinations of the chest includes many things. It might mean a heart examination which in certain cases requires only a fluoroscopic examination and a single plate made at six foot plate target distance, for a teleroentgenographic report, while a study of the lungs for tuberculosis would necessitate the making of stereoscopic plates, in most cases. A study of the mediastinum requires plates made in oblique and lateral positions and it is likewise necessary to have specific instructions as to the method of procedure. While perhaps one might say that the careful roentgenologist, given a request for a chest examination, would fluoroscope with care the heart, mediastinum, esophagus and lungs and make plates in all directions, including the spine, yet time and expense are to be considered while more specific instructions and history would save both. Clinical data in certain cases stimulate further study for the roentgenologist without limiting him to certain routine methods. In making a request for a study of the lungs for possible tuberculosis it would be better to state "Examine for possible tuberculosis of lungs, suspicious area in upper or middle lobe or area, such as third interspace, nipple line, anterior. The clinical history is as follows: T. B. present, or absent, in sputum; excessive or no expectoration; evening temperature; loss of weight." The type should be specified, such as acute or chronic, active or chronic inactive. The experts on diseases of the chest may say that they can make a diagnosis of tuberculosis without the aid of the roentgen ray. The roentgenologist does not deny this, but if such be so, is it not proper that the clinician state his views of the case? Many are willing to take the roentgenologist's opinion. Therefore, the latter should have the opinion of the chest expert. The roentgenologist has not the time to devote to auscultation and to the taking of the history as it should be done; neither has the clinician time for the making of roentgenographs. The history of pneumonia and the complication such as empyema, pleurisy, abscess, should always be included. Do not leave out the occupation, as this is just as important. Lungs of coal and metal workers sometimes show confusing shadows, although to the trained eye of the roentgenologist they may easily be interpreted. While one in civil practice might have time to take extended clinical notes, the roentgenologist in a large active hospital, in either army or civil hospital work, finds no time for history taking. The roentgenologist who interprets the plates may not have made them or even have seen the patient.

The shadows of the pneumonias are frequently confusing and may resemble tuberculosis. The thin and dense radiating lines, the remains of an old pneumonia, may be all that is considered of importance in a suspicious T. B. chest and reference to the history may state that the case had pneumonia ten years previously.

The early stages of metastatic carcinoma of the lung are not always easily interpreted. The history of a breast tumor having been removed, even if one has no pathological report, is sufficient to excite one's suspicion. Pain, though often an unreliable symptom, may be misleading,

while notes taken by the attending surgeon or nurse may be of assistance.

The request for a heart examination without clinical data is common, yet how few wish to give a frank interpretation without some history. The roentgenologist wishes to know if the Wassermann was positive or negative. Perhaps much too frequently a mediastinal condition is called aortitis. Then there are cases in which a negative Wassermann will cause one to look for other cause.

The clinician who sends a patient with the request for an abdominal roentgen-ray examination is stating that you know more about the case than he does. A request for a stomach examination is not specific. He might have wanted you to examine the gall-bladder and as this was not mentioned, no preparation of the patient was made for gall-bladder study. The differential roentgen diagnosis between old gall-bladder disease and adhesions about a leaking duodenal ulcer may be difficult in some cases, while the clinical history may give the additional help in the final interpretation. Blood in the vomitus, blood in the stool, is of just as much value to the roentgenologist as to the clinician. If the patient has not made these observations the nurse no doubt has recorded them on the history chart. If a patient presents symptoms referable to the upper right quadrant, mention should be made in the request, stating that roentgen-ray study is desired of this region. Patient gives history of an old duodenal ulcer associated with gall-bladder disease. After a careful examination, one plate of a series may show gallstone shadows, while a request for a fluoroscopic examination of the stomach would have given negative findings. In a routine examination of the gastro-intestinal tract, the clinical history is essential to the roentgenologist and the one who fails to grasp every small bit of history is doing a great injustice to all concerned. Many careful roentgenologists in examining a patient presenting general abdominal symptoms, include in that examination the gastro-intestinal tract, gall-bladder, kidneys, ureters and bladder, as well as the spine. This is all very well and is most advisable in civil work or in clinics; but for the roentgenologist of a busy army hospital it is unnecessary.

A request for one kidney should never be complied with, but the entire urinary tract should be included. A plate showing an enlarged kidney outline may help one in suggesting that there is a hypernephroma or a pus kidney, and with the information that the urinalysis shows pus or blood, added confidence is given to the diagnosis. Yet the roentgenologist is seldom given this information. A case referred for gastro-intestinal examination but having symptoms also referable to the chest in which the fluoroscopic examination showed an old pneumothorax and negative gastro-intestinal findings, proves interesting to the roentgenologist but somewhat embarrassing to the clinician. While, had mention been made in the request to examine the chest, it would have avoided all suspicion on the part of the roentgenologist of any laxity in the clinician.

Carelessness of ward surgeons in not giving specific directions as to the possible locations of fractures, causes extra work for the roentgen-ray department. When a patient comes for examination with the request for roentgen-ray examination of fracture of the leg and his leg is covered with splints and bandages, it is easy to place on this bandage a pencil or ink mark and state on the request the designated area to be taken; yet this detail, though simple, is often neglected and the roentgenologist should not remove splints or bandages without the permission of the attending surgeon. If no careful examination has been made to determine the possible location of a fractured bone, it should be so stated on the request, and the roentgenologist will include a sufficiently large area to make certain that he has not overlooked a fracture. He should report the area examined, and if on a later inspection of the examining physician, the sus-

pected fracture is not in the area specified, the latter will return the case and not hold the roentgenologist responsible for failing to locate and report the fracture.

Of recent years the roentgen-ray study of diseases of bones and bone tumors or new growths has given to the literature much valuable information, and although the roentgen-ray plate gives in a general way a characteristic shadow which corresponds to a definite pathological classification, yet few of us wish to pin our faith to this classification without some clinical data.

As to stereoscopic plates and the request that such be made, this method of examination should as a rule be left to the decision of the roentgenologist, who should know whether stereoscopic plates will give better or more accurate information. Stereoscopic plates have great advantages over the single plate method for study and are often more essential than anterior, posterior and lateral views. But the request that stereoscopic plates be made in all cases of fractures, is unnecessary. It is seldom necessary to make stereoscopic plates in the simple fractures but for the proper adjustment of compound and badly comminuted fractures, the stereoscopic plates give the surgeon much added information that might not be available by the single plate. In such cases it is the duty of the roentgenologist to encourage the surgeon to view the plates before attempting operative procedure and if he so desires, to be present at the operation to give any added information which may be of value in the readjustment of fragments.

Fluoroscopy (with the use of the bedside unit in the operating room) may serve to assist the surgeon in the better reduction of fractures. This work would require little effort on the part of the roentgenologist, and it means cooperation and team work.

Now, that suggestions have been offered to the clinician, a little advice to the roentgenologist as to the report of his examination seems essential. The reporting of the roentgen-ray findings is an art and is tempered by experience. There is one word to emphasize and that is "conciseness."

Remember that the attending physician or surgeon is also busy and his opinion of the roentgenologist is not advanced by an extended report or detailed explanation of everything seen on the plate. He desires facts, clear, concise, to the point, so that in few words he may grasp your interpretation. Do not tell the surgeon or orthopedist that he should readjust a fracture. He may not consider it necessary. That point is up to him, but you can tell him how much displacement there is, that "the general line of position in the cast is not good," and give him the degree of displacement.

It is not the intent of this paper to criticise adversely, but to offer facts and suggestions with the prospect and purpose of stimulating better cooperation among roentgenologists and other medical men.

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MILITARY STIMULATION OF CHEST ROENTGENOLOGY

Roentgenology of the chest, with respect to both its medical and surgical aspects, has received much stimulation from the influence of diagnostic activities in military work. With the possible exception of the head and face, the thorax was the region which, more than any other, afforded great opportunities for the roentgenologist in war work. At the various camps and cantonments in this country he had such chances unnumbered, afforded by influenza and its attendant evils. Overseas, direct and indirect damage produced in the chest by projectiles was prodigious in amount. In such cases, the military roentgenologist in France could detach himself from the field of mere routine and, if time permitted and the spirit moved, could pursue almost unlimited research. The immediate and the more remote aberrations presented by lung and pleura were as great in variety as they were in amount; and with stereoscopy at his command, he was enabled not only definitely to aid the immediate efforts of the surgeon, but also later to assist the physician in his periodic observations of what are usually long and protracted cases.

The end is not yet, by any means. The pulmonary and pleural conditions which have been set up by the traumata of war, as well as by the damage of acute and chronic infections, will persist long after the more classic wounds of warfare have healed; and as civilians we shall continue to see them in our practice. Let us be prepared to embrace this new material as a basis for our future scientific studies.

PERCY BROWN.

ROENTGEN DIAGNOSIS OF LUNG DISEASES

Progress in the roentgen diagnosis of diseases of the lung, especially of tuberculosis, has always been retarded by a lack of cooperation between the clinician and the roentgenologist. The clinician has regarded the labors of the roentgenologist either with distrust or with child-like credulity, according to his bent. For this distrust there has unfortunately been some foundation. The fantastic diagnosis arrived at by some roentgenologists from a poorly exposed and developed plate made in the dorsal recumbent position at a distance of 20 inches, are not

likely to commend themselves to a clinician of experience. An antiquated and inexact terminology, which has no basis in the pathology of the lung, is used in making reports of the findings, and the mystified clinician, lost in the mazes of "peribronchial infiltrations" and "linear interweavings" wonders whether his patient has pulmonary tuberculosis or not. In the minds of many able medical men, an unwarranted scepticism has resulted, together with an unwillingness to grant to the roentgen examination the place in the diagnosis of pulmonary tuberculosis which its importance warrants. This finds its extreme expression in one of the latest and best books on diseases of the chest. I quote from Norris and Landis: "The latter (the roentgenologists) arrogate unto themselves an ability to recognize early tuberculous lesions in the lungs which is not warranted. In the first place the earliest manifestations of tuberculosis as shown on the roentgenogram, are not distinctive," etc. This quotation indicates an irritation—to some extent justified—at the extravagant interpretations often made of plates which reveal no abnormality, or merely a faulty technique. On the other hand, such a statement can be inspired only by the grossest ignorance of the demonstrated achievements of the roentgen ray in the field of thoracic diagnosis. In view of these circumstances, the opportunity afforded by our large military establishment for a study of large groups of men by standardized roentgen methods is a matter for congratulation. Such study, and its correlation with the results of clinical examination, cannot fail to clarify our ideas as to some fundamentals of thoracic diagnosis.

Too much has been said and written in the past on the subject of root changes and hilum tuberculosis. It can be justly laid at the door of the roentgenologist that he has popularized the notion of hilum tuberculosis, which has no basis except an erroneous interpretation of his plates. He has thus fostered the conception of an extension of the tuberculous process from the root to the periphery along the peribronchial tissues, a conception which in the vast majority of cases is opposed to the facts of pathology. An emphasis, entirely unwarranted, has been placed on an exaggeration of the radial markings of the lung, to which has been attributed so great a significance in the diagnosis of pulmonary tuberculosis. It is gratifying to note, therefore, that in the reports of extensive roentgen examinations in some of the base hospitals in France, minor importance is assigned to these so-called peribronchial infiltrations, so that by themselves they are not considered an evidence of tuberculosis. The diagnosis of tuberculosis must be based on definite discrete shadows, which begin usually in the periphery of the lung and have no necessary relation to the bronchial tree.

Unquestionably to disclose such shadows presupposes a good plate. One cannot too deeply deplore the tendency, now so prevalent, to attribute a superior, almost a magic virtue to a set of stereoscopic plates of the chest. It is assumed (and it is considered heresy to question the assumption), that stereoscopic plates will supply us with information beyond the scope of the single plate. As a result, the production of excellent single plates is neglected; inferior stereoscopic plates are the vogue, and critical study gives way to phantasy and an optical illusion. It is needless to add that in certain conditions good stereoscopic plates are of material assistance in making a diagnosis, and sometimes are the only means of arriving at a correct one.

It is an unfortunate thing, one which has delayed the universal recognition of the roentgen ray in chest diagnosis, that a controversy still exists as to the relative value of fluoroscopy and radiography. Each undoubtedly has its own field of usefulness and both of them should form a correlative part in any complete examination. Without entering into the merits of the question at this time, there is no doubt that in the rapid examination of large

number of men fluoroscopy is of supreme value. In a rough way it may be stated that in such a rapid examination the clinician looks for râles, while the fluoroscopist seeks infiltrations. The work of the roentgenologist has wider scope, as he determines the actual presence of tuberculosis, while the physical examiner seeks evidence of its activity. It is no wonder, therefore, that he succeeds in discovering a greater number of cases of pulmonary tuberculosis, especially those cases which are latent. This has been the experience in the army camps where rapid work was essential and consequently physical examination suffered in precision. The fluoroscope reveals at a glance the existence of an infiltration, and it must remain a valuable adjunct in checking up tuberculosis in large groups of men. It is not disparaging to the clinician to affirm that a careful fluoroscopic examination sets the seal of certainty on his positive or doubtful cases, and not uncommonly leads to a revision of his negative ones.

H. WESSLER.

COMMUNICATION FROM THE COUNCIL OF NATIONAL DEFENSE

The Council of National Defense authorizes the following:

Early in February each physician in the United States exclusive of those who served in the Medical Corps of the Army for the past two years and members of the Volunteer Medical Service Corps, received a communication from the Council of National Defense, requesting that he fill out and return promptly to the Washington office an accompanying questionnaire, so that there may be on file in Washington complete individual information covering the members of the profession. Simultaneously with the distribution of these questionnaires, state and county representatives of the Volunteer Medical Service Corps were instructed to urge all doctors in their communities to comply promptly with the request of the Council to fill out and forward promptly to Washington the blanks sent them; and to advise those who by any chance failed to receive blanks, to communicate with the Council of National Defense at once in order that application blanks might be furnished them.

The Volunteer Medical Service Corps was organized early in 1918 to serve the Government during the emergency of war. As this emergency has ceased to exist, active membership in the Corps is no longer solicited. However, the survey initiated by this organization last year has proved of such value as a source of information concerning the individual members of the medical profession that the Surgeons General of the Army, Navy and Public Health Service have requested the Council of National Defense to complete it so as to include every doctor in the country, in order that a permanent record of the profession may at all times be available for reference in future emergencies. Upon their completion, the records will be transferred to the Surgeon General's Library where they will be kept up to date by a force assigned for the purpose, and be accessible to all government bureaus.

Every physician is requested to cooperate with the Council of National Defense in making this record complete by returning at once the questionnaire received or by writing to the Medical Section of the Council of National Defense, Washington, D. C., and requesting that a blank be sent him if through an oversight he did not receive one.

TRANSLATIONS & ABSTRACTS

BLOCK, E. BATES. The Relation of Oral Sepsis to the Nervous System. (*South. M. J.*, Nashville, Vol. XI, Sept., 1918, p. 606.)

The importance which oral infection plays in nervous diseases is due chiefly to the fact that it is the most frequent situation of focal infection. One of the nervous diseases which has been attributed directly to oral sepsis is neuralgia of the superior or inferior dental branches of the trigeminal nerve. Oral sepsis is not a cause of trifacial neuralgia of the type known as tic douloureux. Cases reported of apical and alveolar abscesses causing mania, melancholia, dementia precox, and hysteria major, need the confirmatory evidence of a greater number of cases before definite conclusions can be drawn. But although it may not be the only etiological factor, oral sepsis, like focal infections in any other part of the body, produces general nutritional disturbances, anemia, and toxic states in which the nervous system suffers like the other organs in the body. An exhaustion psychosis may follow prolonged suppurative conditions of the teeth. The same may be said for neurasthenia, psychasthenia, hysteria, hypochondria, and other functional neuroses; but it is not so potent a factor in the production of these as are diseases of the abdominal and generative organs. The relation of pyorrhea alveolaris and epilepsy is worthy of further study. The relation of oral diseases to distant lesions of nerves that supply the infected regions is commented on, following the report of cases in which this relation was indicated. It would be interesting to know what percentage of cases of bulbar paralysis show oral sepsis.

Goitre has been observed associated with either tonsillitis or pyorrhea alveolaris, but this probably represents merely a lymphatic or neighborhood toxic enlargement. Chorea is not due to tonsillitis except in so far as it forms only one of many points of focal infection in this disease. Both the tonsillitis and the chorea are due to the same germ. Good results are seen to follow the removal of the tonsils between attacks of chorea, and the same results follow the removal of subcutaneous fibroid nodules. Other observations report cases that did no better when the tonsils were removed than others in which they were not removed.

The tonsils may form the nest from which bacteria go out and fortuituously produce disease (depending upon where they lodge) in the ganglia of the sensory roots of the cranial or spinal nerves with a predilection for herpes facialis or labialis rather than herpes zoster, or the infection may invade the medulla, producing bulbar paralysis, or the spinal cord, producing myelitis. Herpes zoster or spinal myelitis, if due to oral sepsis, must be explained on a hemogenic theory.

The mere removal of the focal infection does not necessarily cure the secondary disease, as the infection may have extended beyond the point of the focal infection, and the best results are obtained by the prophylactic effect of the removal of the focal infection, or by the toxines from the point of focal infection.

ROBERTS, STEWART R. Discussion—Symposium on Oral Sepsis. (*South. M. J.*, Nashville, Vol. XI, Sept., 1918, p. 609.)

It is necessary to examine each tooth separately and individually and to compare that tooth with its fellow on the opposite side. Dead teeth, crowns, and bridges are to be suspected. There is a catarrhal gastritis, occurring chiefly in young women, in which the three chief symptoms are: belching, anorexia, and epigastric pain due to an oral sepsis. Free drainage is necessary and possibly explains why there is not more extraoral pathology. Gastric ulcer has been thought to be due to certain probable causes, and while it is one thing to have oral sepsis, it is another thing for all sepsis to cause extraoral pathology.

The *x*-ray man per se is a medical photographer, and the diagnosis and quick judgment should be left to the dentist, the physician, and the surgeon.

PAULLIN, J. E. Discussion—Symposium on Oral Sepsis. (*South. M. J.*, Nashville, Vol. XI, Sept., 1918, p. 609.)

It is difficult to determine in the great majority of cases whether or not there is oral infection, particularly in the molar teeth of the

upper jaw, especially of the last two molar teeth of the upper jaw. Oral infection does not necessarily mean that it is the cause of the particular complaint from which the patient is suffering. It is a question whether or not anything short of the extraction of a tooth with a marked periapical infection, and with an osteomyelitis, followed by the curettement of the focus, will do any good. In some cases amputation of the roots followed by curettement has completely removed the infection, to judge by subsequent ray examination. But in other cases teeth treated in exactly the same way have not recovered, and the focus of infection still remains. Because a man has an infected tooth, extraction does not necessarily follow. The patient should be sent to a competent dentist for treatment and decision.

COOLIDGE, EDGAR D. A Discussion of the Responsibility of the Dental Profession in the Diagnosis and Treatment of Conditions in and about Root Canals. (*Dental Items of Interest*, Vol. XL, July, 1918, p. 515.)

Where a vital pulp is to be removed, a roentgenograph should be taken to reveal the condition, number, size, and direction of the root or roots. Where a root is very crooked or constricted, the pulp should be retained if this is at all possible. In interpretation of periapical involvement, it is difficult to determine the exact extent of absorbed bone. It is difficult in some cases to determine whether such an area is partly caused by the normal bone canals and foramina, or whether it is pathological; and it is possible to overlook such an area where a very heavy plate of bone exists, on both labial and lingual sides. There may be definite evidence in the roentgenograph of an area or cavity and the tooth over it may contain a vital pulp. Clinical evidence is necessary.

PRICE, W. A. Abstract of Discussion on Chronic Mouth Infections in their Relation to General Diseases. (*J. Am. M. Ass.*, Vol. LXVII, Sept. 16, 1916, p. 854.)

Devitalized teeth must be extracted. Researches in the Research Institute of the National Dental Association have not been able to sterilize one single canal; medicine used included sulphuric acid and formalin and others not to be used in ordinary conditions which were used as part of the experiment. The area beyond the tooth apex cannot be sterilized by any means, but dentists can so change the balance of safety for the patient that nature may have a chance to destroy the reduced infection.

BYRON C. DARLING.

UHLER, H. S. The Geometry of Image Formation in *X*-ray Analysis. (*Phys. Rev.*, 11, Jan., 1918, pp. 1–20. *Science Abstracts.*)

The paper deals with the general theory upon which the construction of *x*-ray spectrometers and spectrographs should be based. General equations are derived for the incident and reflected rays, and it is shown that in general not more than two rays can be constructed when one point on the incident segment, one on the reflected segment and the glancing angle are given. The following theorem of the focal circle is proved in a perfectly general manner: all rays lying in a plane perpendicular to the axis of rotation of a plane selective mirror—the axis coinciding with the mirror (pure rotation)—and radiating from a single point will, after reflection, pass through two focal points each of which is at the same distance from the axis as the radiant point, the angles of deviation of the axial or principal rays of the pencils being numerically equal to twice the constant glancing angle. This fundamental theorem is not new as demonstrations of it involving only elementary non-analytic geometry have already been given by Bragg, Wagner, and others. The theorem involves the following assumptions: (*a*) The rays of a pencil must all lie in one plane perpendicular to the axis of rotation of the crystal, (*b*) the rays must not penetrate the crystal to a finite depth, (*c*) the reflecting plane must contain the axis of rotation, and (*d*) the slit must act as a mathematical line source.

It is shown analytically that a circular envelope arises when the reflecting plane is parallel to the axis of rotation but does not contain the axis. Special properties of this locus are demonstrated. Rays having finite angular altitude produce asymmetric broadening of the spectral images even when the azimuth is zero. When the angular altitude is constant and the azimuth is finite and variable, the bundles of rays have astigmatic properties.

This broadening is always in such a direction as to lead to too large a value for the glancing angle. The effect of tilting the reflecting planes of atoms with respect to the method [Abs. 666 (1914)] was again used. The various modes presented by the secondary lines are shown diagrammatically. Besides these a number of lines show a considerable broadening toward the red side in strong fields. The wave-lengths of these seven broadened lines range from λ446.1 to λ4764.0, and in all cases the *s*-component shows the effect, while with λ4511.9 and λ4764.0 the *p*-component is also broadened. Including the broadened lines, 15 affected lines have been discovered besides the 17 given previously [Abs. 955 (1917)]. It was noticed that the outer components of the Balmer lines often extended beyond the unaffected neighboring lines belonging to the secondary spectrum. According to Stark, the carriers for the Balmer lines are the positive atomions, while those of the secondary spectrum lines are the neutral hydrogen atoms. From the effects now observed it seems very probable that the Balmer lines and those of the secondary spectrum are due to different carriers, as there appears to be no mutual influence between them. A. W.

ULREY, C. T. Energy in the Continuous *X*-ray Spectra of Certain Elements. (*Phys. Rev.*, 11, May, 1918, pp. 401–410. *Science Abstracts.*)

The continuous *x*-ray spectra of Pt, W, Pd, Mo, Ni, and Cr have been investigated by the *x*-ray spectrometer method as developed by W. H. and W. L. Bragg [Abs. 1830 (1913)]. By comparison of the areas and max. ordinates of the radiation curves of the above elements it appears that the energy emitted in the form of *x*-radiation in this part of the spectrum is not directly proportional to the atomic weight or the atomic number, but is a periodic function of either, the periodicity coinciding with that of the chemical periodic system.

The continuous spectrum of tungsten has been examined over a range of voltage from 20 to 50 kilovolts. Within this range the following relation between the wave-length of max. energy, $\lambda_{max.}$, and the voltage is found to hold: $\lambda_{max.} V^{1/2} = \text{const.}$ The areas under the tungsten radiation curves are proportional to the square of the voltage between 25 to 40 kilovolts.

A. B. W.

FAXEN, H. Scattered *X*-radiation due to Heat Motion of the Molecules in Crystalline Reflection of *X*-rays. (*Ann. d. Physik*, 54. 8, April 26, 1918, pp. 615–620. *Science Abstracts.*)

In a paper on "Interference of *X*-rays and Heat Motion," P. Debye calculated the effect of heat motion of the crystal molecules on the reflecting properties of the crystal [see Abs. 1078 (1914)]. The author now calculates, as a direct consequence of Debye's work, the extent of the scattering produced by heat motion. In general, his results are in agreement with Debye's; but it is also shown that the scattered radiation reaches its maximum value in the neighborhood of the interference maxima—in which case Debye's formula for scattering no longer holds. A. B. W.

DERSHEM, E. Resolving Powers of *X*-ray Spectrometers, and the Tungsten *X*-ray Spectrum. (*Nat. Acad. Sci.*, Proc. 4, March, 1918, pp. 62–65. *Science Abstracts.*)

From simple considerations of crystal reflection the author shows that the resolving power of a given crystal may be expressed as follows:

$$\lambda/\Delta\lambda < nr\lambda/[d \cos\theta\ (s + 2t \cos\theta)],$$

where λ is wave-length of *x*-radiation reflected at the angle θ, d the "grating space" of the crystal, s the width of the *x*-ray beam, t the thickness of the crystal, and n the order of the spectrum.

From this expression it appears that the resolving power may be increased by increasing the order of the spectrum and the distance between the crystal and the photographic plate, and also by decreasing the width of the source and the thickness of the crystal. To increase the resolving power by any of these means results in a loss of intensity which must be compensated for by an increased time of exposure.

Using a Coolidge tube, with tungsten target, and reflecting from a rock-salt crystal the author has made a series of careful measurements of the wave-lengths in the *x*-ray spectrum of tungsten. The results, which are tabulated, are claimed to be accurate within 0.1% in the case of L-radiations and 0.8% in the case of K-radiations. In the case of the L-lines the resolving power, as defined above,

was less than 170, but nevertheless 19 separate and distinct lines were obtained. A. B. W.

HALL, E. H. Thermal Conductivity in Metals. (*Phys. Rev.*, 11, April, 1918, pp. 329–330. Abstract of paper read before the Am. Phys. Soc., Dec., 1917.)

It is generally admitted that there are free electrons in the interatomic spaces of a metal and that their number increases with temperature. Hence there must be, in a detached metal bar hot at one end and cold at the other, a mechanical pressure tending to drive the free electrons down the temperature gradient. If this tendency prevails, even to a slight extent, it makes the hot end of the bar electrically positive and the cold end negative. It is then argued that the electrons will function somewhat like a vapor, and will absorb heat at the hot end and will give it out at the cold. A few numerical data are given in support of this idea. E. H. B.

JACKSON, CHEVALIER. Acromegaly of the Larynx. (*Journal A. M. A.*, November 30, 1918.)

The writer describes four cases of acromegaly in which the structures of the larynx participated in the enlargement. He points out the very slight attention which has been given to the condition of the larynx in acromegaly, especially in view of the frequency with which changes are noted in the voice, and emphasizes the need for examining the larynx in every case. The overgrowth of acromegaly involves the laryngeal cartilages and soft parts and may produce stenosis sufficient to require tracheotomy to prevent asphyxia. The laryngeal image seems frequently to be asymmetrical, though the external enlargement is usually symmetrical upon palpation. The altered voice of acromegaly may be due to the laryngeal changes; alterations in the resonating cavities, etc. Acromegalic overgrowth should be excluded in all cases of apparent laryngeal hyperplasis.

DEUTSCH. *X*-ray Diagnosis of Syphilis. (*Centralblatt für Chirurgie*, 1918, Vol. XLV, p. 313.)

This is the case of a man aged twenty-six who suffered from dyspnea, cough, and a high temperature. He stated that at times, he coughed up blood. The roentgen ray examinations showed anteriorly that the left apex was indistinct, posteriorly, shadows obscured both apices. In the right lung there were isolated patches. The hilus was sharply outlined. On the left, there appeared on dorsoventral transillumination at a corresponding level with the lobes, a deep linear shaped shadow, the apex of this shadow being directed toward the hilus and pointing outward. The lower portion of the lung was obscured. There was little movement in the diaphragm, and the left of the heart was obscured by shadows. The aorta seemed normal and lying in a free mediastinum. On inspiration, the mediastinum did not seem to be dislocated into the healthy half of the thorax upon sagittal transillumination. Tubercle bacilli were not discovered. A positive Wassermann reaction was found. The patient showed a marked improvement under mercurial treatment which was followed by a change for the worse and a distressing cough. He expectorated foul smelling greenish masses of mucus which seemed to come from the lower air passages and to relieve his inspiratory stridor. He suffered from dyspnea, his respiration was superficial, and he was hoarse. A second roentgen-ray examination showed that in the earlier dense shadow in the center over the base of the left lung, was a nuclear shaped area of clarity and this appeared more like a retiform structure whereas the balance of the lung remained the same as before. The patient died. The postmortem findings showed that the roentgen ray should have been interpreted as follows: The central wedge shaped shadow corresponded to the thick layer of pleural inflammation in addition to the thickened bronchial walls and the secretion filled cavities. When part of the secretion in these cavities was removed by coughing, as a result of the treatment, the shadow became more clear. On account of its position along the lowest portions of the upper lobe, the picture shown resembled that of an interlobular exudate which was distinguished principally by its form with the base turned toward the hilus. The shape of these shadows appears to be characteristic of the most usual form of pulmonary syphilis. It may also furnish an indication in making a diagnosis. The pleural affection is usually present at an early period of the pulmonary fibrosis. Treatment should begin early if the condition is recognized.

SCHREINER, BERNARD F., SIMPSON, BURTON T., and MUELLER, THEODOR, Buffalo, N. Y. Diagnosis and Treatment of Basal Cell Epithelioma, with the Report of 59 Cases. (*Am. J. Surg.*, January, 1919, Vol. XXXIII, p. 1.)

"This is Harry H. Hagen's classification, in his book on 'Skin Cancer,' of basal cell epithelioma:

1. Flat rodent ulcer.
2. Nodular epithelioma.
3. Rolled edge epithelioma.
4. The depressed scar-like cancer.
5. Morphea-like.
6. Fungating epithelioma.
7. Deep ulcerating.

"As the basal cell epithelioma of the skin is a superficial tumor, it, therefore, does not seem difficult to destroy all cancerous tissue and thus obtain a permanent cure. Even rather advanced cases are amenable to treatment. The infrequency of metastases increases the chances for a permanent cure, yet in spite of this there are among our cases many who had previously received medical attention without success. *X*-ray, caustics, and the thermocautery had been used or the tumor had been removed surgically. The effect was either a speedy recurrence after temporary healing, or a more rapid extension of the lesion.

"For the treatment in our cases we used the following procedures, either alone or combined: fulguration, excision, radium and *x*-ray treatment.

"Fulguration has only a local effect which is practically the same as cauterization or coagulation of the tissue. It does not possess any advantage over the thermocautery in the treatment of basal cell epithelioma. We treated only two cases with fulguration. One of them healed promptly within 23 days, the other was fulgurated several times but remained stationary and healing at last was obtained by radiation.

"Six basal cell epitheliomas were excised. All patients so treated were healed and remained well, some of them for more than three years. This success may be explained by the fact that we operated only on carefully selected cases. Not all cases, owing to their size and location, can be dealt with surgically.

"In 19 cases we applied radium. We used it in the form of radium bromide, of which 51 mgs. were applied in metal applicator. In 9 cases the treatment was successful and a clinical cure has been obtained. One of these cases, however, sustained a severe radium burn which healed only after eight months. In another case of this group it is doubtful whether the success can be ascribed to the effect of the radium alone. This patient with an ulcerated lesion on his nose had been fulgurated twice without success. Then he received within sixteen days two mild erythema doses of unfiltered *x*-rays, whereupon his lesion showed considerable improvement. Eight days after the last *x*-ray treatment, before the full effect of the *x*-rays had time to develop, the ulcer was radiated for three hours with radium. It is, therefore, not improbable that this lesion might have healed without the radium application. The favorable influence of the radium rays in the successful treatments could usually be noticed after two weeks, while it took from 1–2 months from the beginning of the treatment until the lesion had disappeared. One patient is still under treatment, almost well. In the nine remaining cases the radium treatment did not prove satisfactory. Some of these showed at first some improvement, but then remained stationary; in one case the ulcer even progressed. Three of these cases which were refractory to radium were later on treated with *x*-rays and were healed promptly. On the other hand, among these nine cases were four which had not responded to many applications of the *x*-rays and which also could not be influenced by radium. Our success with radium in basal cell epithelioma (50%) is, therefore, not very encouraging. Perhaps the amount of radium at our disposal is not sufficient for all cases, though it was large enough to produce a burn; perhaps we have not yet found the proper technic as to the filtration and doses of the radium. It is also possible that the failure of the radium treatment in some cases is due to the quality of the radium rays; their wave-length is probably too short and their penetration too high to be sufficiently absorbed by the tissue.

"Fifty-four cases have been treated with *x*-rays. They can be divided into two groups. The first group contains thirteen cases which were treated with fractional filtered and unfiltered *x*-ray doses of varying penetration. Most of these cases showed a slight erythema; four of these thirteen cases remained refractory after temporary improvement. The other nine

cases were pronounced clinically well within 3–10 weeks and are well at this time.

"The second group contains forty-one cases, eleven of which are still under treatment. With these the object was to destroy, if possible, with a single erythema dose all carcinomatous tissue. All were ulcerated, and in all the ulcerated lesion healed. In only one instance the scar remained slightly elevated. It is to be regretted that this patient did not report for further observation and treatment. All other cases (97%) healed with scars that were quite satisfactory from a cosmetic point of view. The deliberately produced erythema of the skin did not inconvenience the patient in any way and disappeared after 2–3 weeks. The first improvement was usually noticed 1–2 weeks after the application of *x*-rays. The time required for healing varied between 3 and 6 weeks and depended upon the size of the new-growth. The time necessary for healing was prolonged somewhat in two patients who suffered from very extensive tumors which had already invaded the deeper layers of the subcutis.

"The difference between these two groups is too great to be overlooked and speaks decidedly in favor of the so-called 'massive dose treatment,' which consists of few rather powerful applications, as recommended by MacKee and Remer and by Pusey. The treatment with frequent small doses, the so-called 'fractional dose' method, originated from the idea that it would not damage the healthy skin and tissue overlying the tumor. Of course it is absolutely necessary to pay strict attention to the skin when giving the so-called 'deep *x*-ray treatment,' but the basal cell epitheliomas of the skin are more or less superficial tumors of the cutis and subcutis that ulcerate and, if not cured, will destroy the skin progressively and much more thoroughly than it could ever be damaged by two or three erythema doses given at intervals of 3–4 weeks. It is a well-known experience of all who treat neoplasms with *x*-ray or radium that tumors may become resistant against radiation by the application of many small doses and then will continue their destructive growth uninfluenced. We have several such cases in the first group of our *x*-rayed patients. In our opinion the risk of underdosing when treating with *x*-rays is usually very much under-rated. The consequence of underdosing in a skin epithelioma is much more serious than a marked acute erythema of the skin that disappears in 2–3 weeks without leaving any trace. It is, moreover, not at all impossible that the hyperemia of the skin produced by the erythema influences favorably the progress of healing. Though we know very little at present about the mechanism of healing after *x*-ray treatment, it is conceivable that besides the destructive effect of the rays on the cells, cytolysins which are present in the blood may play an important part. From this point of view a deliberately produced hyperemia may therefore increase the direct effect of the *x*-rays. We can absolutely limit the effect of the rays to the smallest possible area by using proper diaphragms and by covering the surrounding skin with sheets of rubber impregnated with lead. The only danger is that we may choose too small an area, the consequence of which will be a recurrence.

"When treating skin epitheliomas, as a rule, we do not use any filter, so that all rays may be brought to bear upon the lesion. The hardness of the rays, which depends upon the hardness of the tube, and which can be changed at will when a Coolidge tube is used, varies in our treatments according to the depths in which the rays shall be absorbed. The effect of the rays is probably greatest in those tissue layers where they are absorbed, not in those which they penetrate. For tumors in the cutis and superficial layers of the subcutis we use rays of 3–5 Benoit penetration. In large fungous tumors we use rays of 6–8 Benoit penetration.

"When treating according to these principles, many of our patients required only one erythema dose for a clinical cure; some rather advanced tumors required repeated radiation, which was given at intervals of about three weeks. In one case of an unusually large fungous tumor we repeated the erythema dose at intervals of a few days to two weeks until the epithelioma undoubtedly showed signs of regression. No damage to the skin was done, special care for its protection having been taken.

"A comparison of the different methods of treatment which we used gives the following result:

Excision	100%	clinical cures
Radium application	50%	" "
X-ray application		
fractional dose method	69%	" "
massive dose method	97%	" "

The highest percentage of clinical cures has been obtained by surgical procedure and by heavy *x*-ray treatment, both of which a patient can get everywhere without great expense.

"When shall we advise a patient to be operated? When shall we apply *x*-rays?

"The excision of a basal cell epithelioma is usually only a minor operation which can be made under local anesthesia. If done aseptically the wound heals within 8–10 days with a linear scar. The condition essential for such a perfect result is that we can operate within healthy skin and yet have sufficient skin to close the defect. It is the consideration of the cosmetic effect which so often causes the surgeon to fail to reach the safety zone. Sometimes the localization of a basal cell epithelioma is unfavorable for excision, e. g., the nares, the tip of the nose, the nasolabial grooves. That our percentage of clinical cures is higher with operative treatment than with *x*-ray treatment is due to the fact that we only operated on carefully selected cases while cases were admitted to *x*-ray treatment just as they came in, whether beginning or advanced.

"It is an advantage of the *x*-rays that they can be applied on all parts of the body surface and against lesions which are so far advanced as to be inoperable. The time necessary for healing is decidedly longer than that with an operation, but the chances for complete success are much greater. Almost unconsciously we expose to the *x*-rays a much larger area of healthy skin than we would excise in an operation. In order to excise all malignant tissue which *probably* may exist in the neighborhood of lesions, we usually have to sacrifice large portions of healthy skin, while, when using *x*-rays, the healthy skin which has been exposed to the rays remains intact and yet all malignant tissue beneath it has been destroyed.

"There is one dangerous feature in *x*-ray treatment of skin epitheliomas, and that is the tendency toward underdosing. As long as we treated with numerous small *x*-ray doses the percentage of our clinical cures was only 69% and we saw a few cases become refractory against the rays. On the other hand since we instituted massive dose treatment we have had 97% of clinical cures and we have not met one basal cell lesion that was refractory. Among our patients were quite a few who had had *x*-ray treatment elsewhere without success and who only reluctantly submitted to a renewed *x*-ray application. One or two erythema doses were sufficient in every one of them to produce a clinical cure. At present we no longer operate basal cell epitheliomas except for purposes of research. We treat them with erythema doses of *x*-rays and are well satisfied with the clinical results. When we emphasize the danger of underdosing, we do not mean, however, to recommend a reckless indiscriminate radiation of skin cancers with the causation of severe burns. What we advocate is the application of such doses of *x*-rays as will secure the maximum destructive effect on the cancer cells and yet do no permanent injury to the skin. This dose has been reached with our machine and our treatment tube when a simple erythema of the surrounding skin appears after a few days. It is true that this massive dose treatment can only be given by experienced radiologists, who are well acquainted with the output of their *x*-ray equipment and know the erythema doses of their individual tubes and for the different kinds of rays.

"We know well, of course, that a clinical cure is not yet a permanent cure. As to the length of time which must elapse after a clinical cure has been obtained and before a permanent cure can be pronounced, opinions differ widely. Experience shows that the closer all cases of epithelioma with clinical cures are followed, the more this period of observation must be prolonged. Without entering into a discussion of this difficult question, it does not seem improbable that in explaining especially later recurrences, not only anatomical local factors (incomplete destruction of the lesion) have to be considered, but also the resistance of the whole organism against the development of malignant neoplasms. More recent researches into the etiology of cancer seem to indicate that in the development of cancer, besides local factors as chronic irritation, chronic infection, misplaced cells, etc., a more general change in the cell-metabolism of the whole organism also plays an important part. This, too, holds true for the basal cell epitheliomas of the skin, and makes us hesitate to pronounce a permanent cure, even after years of observation. Moreover, the multiplicity of primary basal cell tumors in an individual is an established fact. Such a microscopic primary focus may be present and be unnoticed in the neighborhood of a larger lesion and escape

treatment. It continues to grow and will later cause an apparent 'recurrence.' As basal cell tumors are usually of exceedingly slow growth this may take years.

The period of observation of our patients varies between several months and 3½ years. For pronouncing a clinical cure it is not sufficient that an ulcerated lesion is simply healed over. One of our patients had a small ulcerated epithelioma in the cheek. It was treated with many small *x*-ray doses without success, but healed over after two applications of radium, leaving a slightly elevated scar. During months of observation this scar did not show any sign of clinical recurrence. For reasons of research the scar was excised and we found beneath the new formed skin some still malignant tissues of basal celled type. Very often slight elevations or thickenings remain at the site of the healed lesion. These thickenings have, therefore, to be looked at with the greatest suspicion and the treatment has to be continued till they have absolutely disappeared. With this precaution, a recurrence will be very exceptional. We have at various times excised such scars and examined them microscopically, and have never found any sign of malignancy."

LIPPMAN, C. W. Communication on Postinfluenzal Empyema and Lung Abscess. (*Cal. State Medical Journal*, Feb., 1919.)

On the Stamford male service in San Francisco Hospital, 23 lung abscesses or empyemata were definitely studied which could be ascribed to influenza in the months of October and November. The four factors which are essential to the early diagnosis of these conditions are:

1. Toxic appearance of the patient.
2. Temperature averaging over 100 during the second and third week of the disease.
3. Persistent leucocytosis of 12,000 and over.
4. Roentgen ray findings.

The physical findings are regarded as of little value.

The roentgen ray findings were of exceeding importance in differentiating pneumonia from fluid.

HEISE, SAMPSON. *X*-ray on Pulmonary Tuberculosis. (*N. Y. State Med. Journal*, Vol. 17, No. 11, p. 429.)

The normal *x*-ray appearance of the lungs is very ably described. A description of the early stage of tuberculosis follows:

"Within the lung fields proper there are changes to be seen which readily tell the experienced observer that some form of pathology exists. These changes are essentially of two distinct physical characters, distinct as to distribution and shape. The first of these changes is characterized by the linear arrangement along the course of the bronchi and blood-vessels of small nodules or somewhat circular shadows. In size they may vary from one millimeter upwards. They appear separate and distinct and give rise to the impression of beading along the ramifications. At times they appear with rather clean-cut margins, but at other times their margins as well as the margins of the pulmonary ramifications appear hazy and fuzzy. They may occur anywhere along the course of the blood-vessels and bronchi, which appear to be accentuated in density. To be of use in diagnosis they should not be considered when in the immediate vicinity of the roots.

"In mottling, which is an early stage, the tubercles are not arranged linearly, nor do they follow a definite outline. Between them is an area of lesser density suggesting patchiness. In addition to the above changes the fan-shaped density of Dunham is described. The dense spots seen in most plates are regarded as evidence of an early tuberculous infection which is healed. In the active stage the tubercles are surrounded by an area of inflammation. This area is shown by the *x*-ray as faint density surrounding the tubercles and causing their margins to appear fuzzy or hazy.

"When the tubercles have become more confluent, and caseous broncho-pneumonia is present—an exudative type of active lesion, this is seen as a more or less dense shadow with irregular fuzzy outline and in which there are no individual tubercles visible."

In the healing lesion this sign of inflammation disappears:

"In the healing lesion collateral inflammation disappears. The margins become more definite and the tubercle more dense, since it becomes fibrotic or calcareous. The area of patchiness of the caseous broncho-pneumonia loses in density, individual tubercles appear, hazy outlines are lost, and the individual tubercles undergo fibrosis or calcification, while the pulmonary

ramifications in the vicinity become more definite and distinct as they become more fibrous. . . .

"So then, although there are certain indications in the *x*-ray plate which would lead us to believe that a focus is active or healed, it would be quite unwarranted and unsafe as a general thing to make a corresponding diagnosis from the plates alone. However, when serial plates are taken at various intervals much knowledge can be gained as to the progress of the disease in the individual. . . .

"The *x*-ray does afford most valuable assistance in the diagnosis of tuberculosis, for it not only tells us of the location and extent of the lesion, but to the experienced observer it also shows the character or type of the lesion much more accurately than can be told by physical signs or symptoms alone. It affords the most exact information as to the actual pathology that can today be gotten short of autopsy. But it must nevertheless not be looked upon as infallible; nor must it be taken as the final word in diagnosis. Its use should rather be for aid and corroboration in diagnosis and for better knowledge of extent and pathology. In pulmonary tuberculosis, as in all diseases, the use of the *x*-ray for diagnosis must be based upon a good knowledge of the pathology and course of the disease, an orientation in it, so to speak."

GOETZE, O. Radiological Diagnosis with a Distended Abdomen; a New Method. (*Münchener medizinische Wochenschrift*, November 12, 1918.)

O. Goetze, in an important article illustrated by thirty figures, sums up the technique and results given by a new radiodiagnostic procedure consisting in distending the peritoneal cavity with oxygen or simply atmospheric air. This causes a sort of dissociation of the abdominal viscera which then become accessible to radioscopy and radiography. For the introduction of oxygen, the writer employs a special apparatus or injects the gas through lumbar puncture needles. A practised hand will readily determine when the needle has entered the peritoneal cavity. The point of puncture should be selected at from three to five centimeters below the umbilicus in the middle of the left rectus muscle, or below the costal margin outside of the hepatic dullness. Insufflation of from two to three liters of oxygen is easily tolerated in all cases. As to contra-indications to the procedure, they are all serious disturbances of the circulation and respiration, acute or adhesive peritonitis (danger of perforating the intestine), etc. The gas is evacuated after radiography has been done. This procedure has not influenced the temperature or pulse in over ninety cases in which it was resorted to. The illustrations show the really remarkable results obtained, revealing as they do peritoneal adhesions, ascites at the beginning, neoplasms of the viscera or abdominal walls, various forms of hernia (among others the diaphragmatic, whose diagnosis is always a difficult, not to say impossible, matter), enlarged mesenteric lymph nodes, changes in the abdominal aorta, caries of the spine and pelvic bones, abscess, the shape of the lower cardiac limits, pericholecystitis, renal calculi, renal changes, splenomegalia, pathologic conditions of the bladder (simultaneous intravesical and abdominal insufflation), growths of the uterus and adnexa, pregnancy, etc.—all examples for the use of this procedure. The writer announces another paper for the near future, the present one being merely preliminary.